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ON THE SAURIANS RECENTLY DISCOVERED IN THE DAKOTA BEDS OF COLORADO.

BY E. D. COPE.

THE formation known as the Dakota was long since characterized by Messrs. Meek and Hayden, from the studies made by the latter gentleman, of the great section exhibited by the Missouri river. Subsequently Dr. Hayden, then as now, the esteemed director of the United States Geological Survey of the territories, observed and defined the same horizon along the eastern flank of the Rocky mountains. Doctor J. S. Newberry, in his reports on the geology of the Colorado basin, has mentioned the same stratum under the name of Lower Cretaceous sandstone, and I have in my report to Lieut. Geo. M. Wheeler identified that part of these sandstones which is seen in northwestern New Mexico, with the Dakota. This formation is then one of great extent and importance. It consists chiefly of sandstones which are sometimes so amorphous as to constitute a quartzite. Among these are interstratified beds of clay, carbonaceous clay, and lignite, some of which may be used as an inferior fuel. These mineral characters show that the formation was, as pointed out by Prof. Newberry, deposited in shallow water during a period of subsidence. He remarks that previous to this subsidence there was an extensive land area; but that it steadily diminished by the encroachments of the ocean. This period of extended dry land, would be regarded by many geologists as a part of the great cretaceous division of time; that occupied in its sinking, and in the deposit of new beds, being now parallelized with the later half of the cretaceous period of the old world scale. In any case the deposit of the sands which became the Dakota rocks, marks the beginning of the cretaceous ocean in North America, and is the No. 1 of Meek and Hayden.

Along both the eastern and western flanks of the Rocky mountains the Dakota beds form a distinctive feature of the landscape. Their hardness has resisted the effects of erosion so that they remain prominent where other beds have been worn away. As all the earlier cretaceous strata lie tilted up against the great central axis, the harder ones form lines of hills or "hog backs," while parallel valleys mark the upturned edges of the softer ones. This role is played by formation No. 2, as has been often shown by Dr. Hayden. The side of the sandstone ridge next the mountains is steep, while the opposite one is sloping, and the summit is is often a narrow ledge. On this elevated perch the ancient Pueblos of New Mexico fixed their rock built houses, courting one peril to escape the greatest of all, the attacks of savage men. To-day these ruined abodes form the resting places of the geologist, the true lover of scenery, who climbs for birds-eye views of his favorite subjects, and for clews to many a knotty problem.

As a shore and shallow water formation, the Dakota should enclose the remains of the plants and animals of the land. And plants have been found in abundance, and have been the theme of an interesting volume of the Hayden series by Mr. Lesquereux, but vertebrate remains were until recently unknown. To ascertain what forms of animal life ranged that unexplored and unexplorable continent, is a problem that stimulated the writer to many excursions among the "hog backs" of Colorado and New Mexico; and many cliffs have been scaled, and many fasts endured without result in this direction.

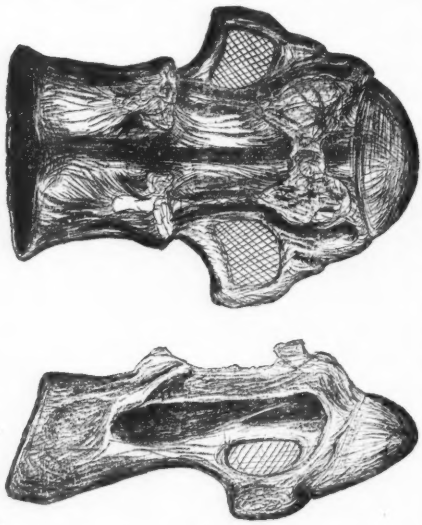

Fig. 1—Cervical vertebra of *Camarasaurus supremus*. *a* from above; *b* from right side. The neural arch is mostly wanting. These figures, like all the others in this paper, are one-tenth natural size.

It was therefore a source of no small gratification to have been in receipt of letters from Superintendent O. W. Lucas, of Canyon City, and Professor Arthur Lakes, of Morrison (both in Colorado and one hundred miles apart), at about the same time, informing me of their simultaneous discoveries of vertebrate remains in the beds of Dakota age, near their respective residences. The bones obtained by the former were found in a rather friable bed, and were easily extracted in good condition. Some of those obtained by the latter gentlemen were from a similar or identical formation,

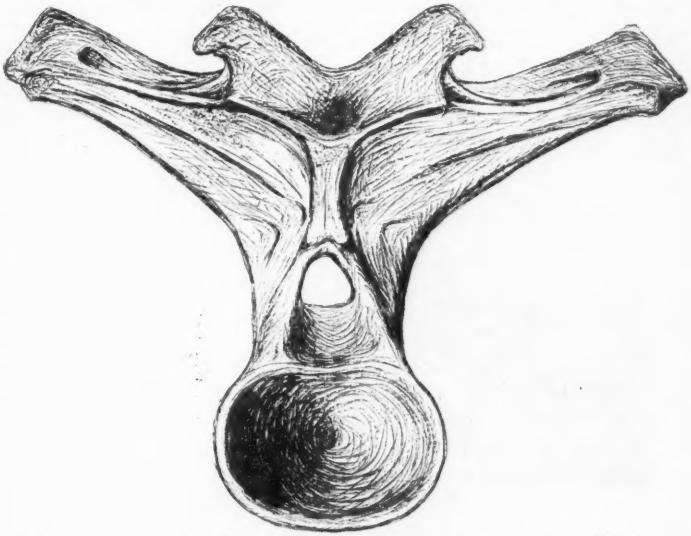

Fig. 2—Anterior dorsal vertebra of *Camarasaurus supremus* from behind.

while others were embedded in the hard sandstone already mentioned. I obtained possession of those from near Canyon city, while those from near Morrison were purchased for the museum of Yale college.

One of the first objects sent by Mr. Lucas is a fragmentary lower jaw of a carnivorous dinosaurian, which he found on the surface of the ground. This fossil was found to belong to a species heretofore unknown, which I referred to the genus *Laelaps*, under the name of *Laelaps trihedrodon*.[1] The second sending included a number of vertebræ, which apparently represent a much more gigantic animal, and I believe the largest or most bulky animal capable of progression on land, of which we have any knowledge. This rep-

[1] Bullet. U. S. Geol. Surv. Terrs. III, 1877, p. 805.

tile I described in my palæontological bulletin No. 26, under the name of *Camarasaurus supremus.* Subsequent sendings included many of the more important bones of the skeleton, which render

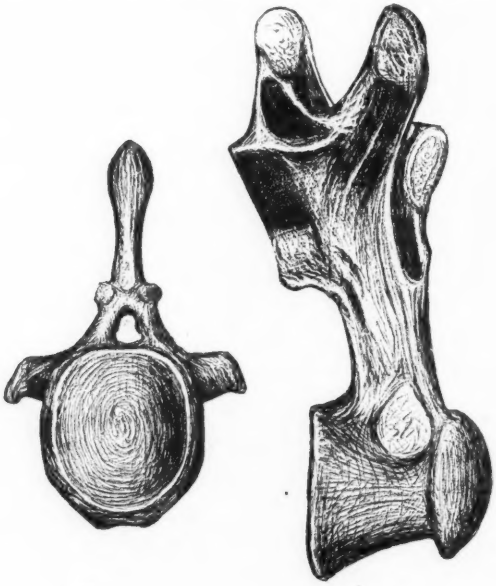

Fig. 4. Fig. 3.

Fig. 3—Dorsal vertebra represented in Fig. 1, the right sight side. Fig. 4—A caudal vertebra viewed from behind.

it comparatively easy to determine the general character of this monster. Later collections received from Mr. Lucas include the teeth of two large species of a new genus which has been characterized under the name of *Caulodon;* and the vertebræ of two genera new to science, which I have named *Tichosteus* and *Symphyrophus.* He also procured remains of two additional forms of gigantic size, fit rivals of the *Camarasaurus,* which I referred to the new genus *Amphicœlias.* A species of tortoise was associated with these saurians, and appears to have been abundant. It is the oldest species of the order yet obtained from American formations, and is not very different from existing forms.

The species of *Camarasaurus* and *Amphicœlias,* which attained to the most gigantic proportions, are remarkable for the light construction of the vertebræ anterior to the tail. In both genera

the centra of dorsal vertebræ are hollow, including two large chambers which are separated by a longitudinal median wall, and communicate with the cavity of the body by a foramen on each side. This is well exhibited by a centrum shown in fig. 6, from which the anterior wall has been removed, and the mineral contents of the chambers extracted. The communication of the latter with the abdominal cavity is seen on the left side, while the foramen of the right side (of the figure) is concealed by its anterior border, which remains.

Fig. 7.

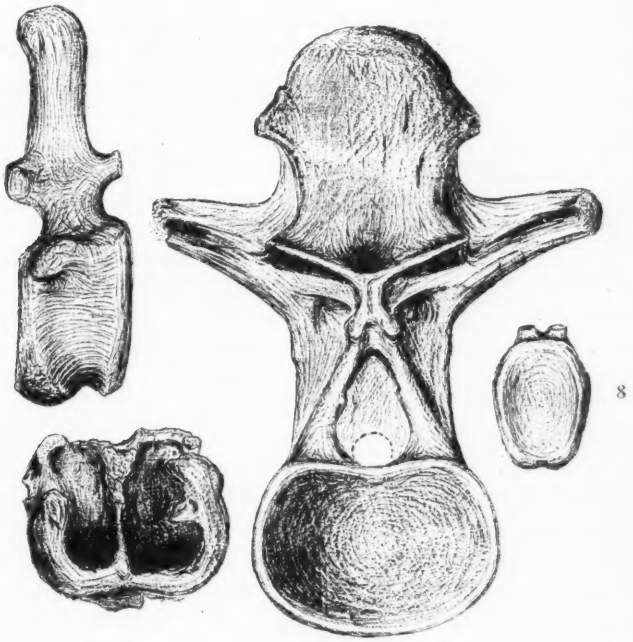

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Fig. 6. Fig. 5.

Fig. 5—A median dorsal vertebra seen from behind, showing the hyposphen. Fig. 6—Centrum of a dorsal vertebra without anterior wall. Fig. 7—Caudal vertebra shown in fig. 4, from the right side. Fig. 8—A more posterior caudal, end view of the centrum.

They are also remarkable for the enormous elevation of the superior arches, and diapophyses, the result of which is to give the ribs an unusually elevated basis, and the cavity of the body much space above the vertebral axis on each side. On the other

hand the bones of the tail and limbs are solid or nearly so, in great contrast with some of the *Dinosauria* of later geological periods.

The manner of the mutual articulation of the arches of the vertebræ in the genera *Camarasaurus* and *Amphicœlias* is very peculiar, and has not been observed in any other animals.

The anterior zygapophyses are separated by a deep fissure, while the posterior zygapophyses are united on the middle line. From the latter from the point of junction, there descends a vertical plate which rapidly expands laterally, forming a wedge whose base looks downward. The supero-lateral faces are flat, and articulate with corresponding facets on the inferior side of the anterior zygapophyses, which look downward and inward, on each side of the fissure above described. When in relation, the anterior zygapophyses occupy a position between the posterior zygapophyses above, and the *hyposphen*, as I have termed the inferior reverse wedge, below. This arrangement accomplishes the purpose effected by the zygosphenal articulation, that is the strengthening of the articulation between the neural arches, but in a different way. The additional articulation is placed at the opposite extremity of the vertebræ, and it is the anterior zygapophysis instead of the posterior one which is embraced. This structure entitles the genera which possess it to family rank, and as the two genera mentioned above belong to different families in consequence of the different types of vertebral centra, the one opisthocœlous, the other amphicœlous, they have been called *Camarasauridæ* and *Amphicœlidæ* respectively.

This structure is readily seen by reference to Figs. 5 and 13, where it is represented in the vertebræ of the two genera from behind. In Fig. 2 it is replaced by a stouter vertical plate of bone, which spreads out a little below. It is seen in profile in Fig. 3. It is not present in the vertebræ of the tail.

The characters of the genus *Camarasaurus* are derived from nearly all portions of the skeleton excepting the skull and ungues. The bones are generally in good preservation.

The vertebræ of the cervical, dorsal and lumbar region are all opisthocœlous or reversed ball and socket. The centra of the cervicals are very elongate, but those which follow them diminish rapidly in length, until in the lumbar region they have but a small anteroposterior diameter. The anterior caudal vertebræ are also

very short and wide; but the length of the centra gradually increases, so that the distal ones are quite elongate. The caudal centra are all moderately amphicœlous.

The sacrum is short and consists of only four vertebral centra, thoroughly coössified. The anterior articular extremity is convex; that of the posterior extremity slightly concave. Its transverse processes are, like those of the other vertebræ, much elevated, although they spring from the centra. The external face of their bases is not prominent, and the spaces between their projecting portions are deeply excavated. The centra are like those of the caudal vertebræ, composed of dense bone. The extremities of the adjacent transverse processes are united, thus enclosing large foramina.

Fig. 9—View of the right side of the dorsal vertebra of *Camarasaurus supremus*, represented in Fig. 5.

The scapula is relatively of large size. It is rather elongate, and the superior extremity is expanded. There is a very large mesoscapular process, which is wanting in *Cetiosaurus*, according to Phillip's figures. It appears to resemble the scapula in *Dystrophæus*.[1] (See Fig. 10.)

The coracoid bone is of proportionately small size. It is of an irregularly quadrate form, with the proximal extremity the shortest. The articular face is large, and is presented obliquely away from the long axis of the plate. There are no emarginations nor intermediate processes, and the perforating foramen is well removed from the border.

Pelvic bones of two forms are present. Neither of them resembles pelvic bones of *Dinosauria*, and are least of all similar to the forms of ilium which are known in that order. One of them is a robust L-shaped bone, one limb of which is expanded into a wide fan-shaped plate; and the other is stouter and of subequal width, terminating in a stout sub-triangular articular extremity.

[1] See Report Lt. Wheeler, Vol. IV, pl. LXXXIII, p. 31.

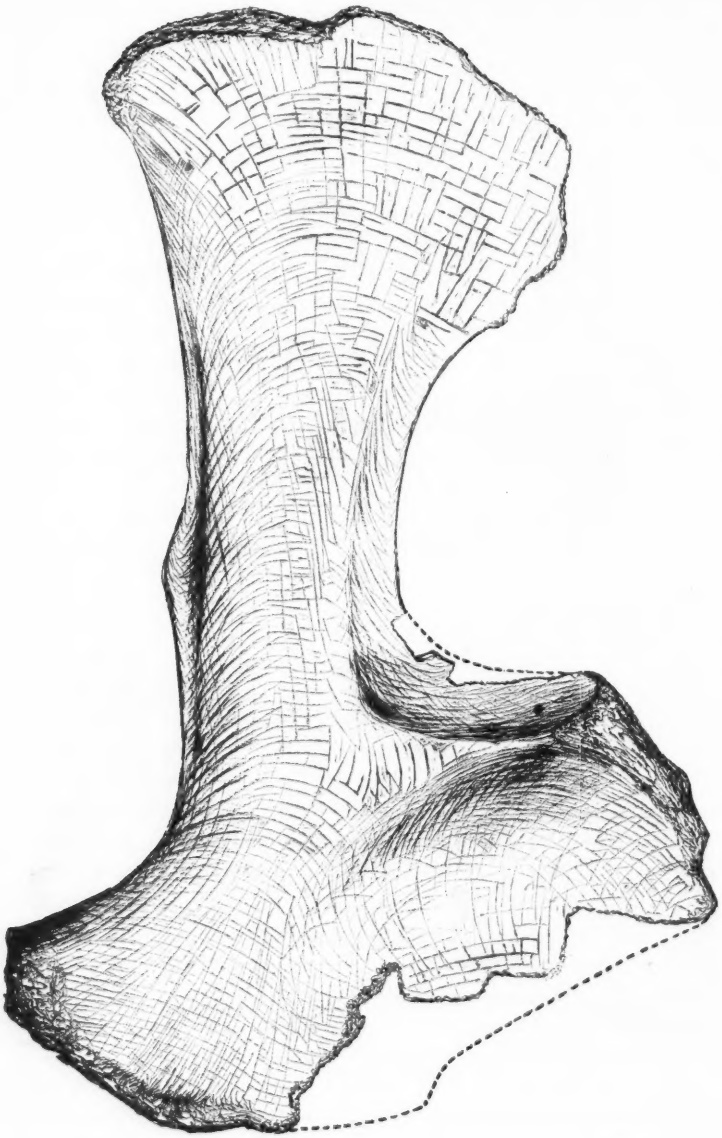
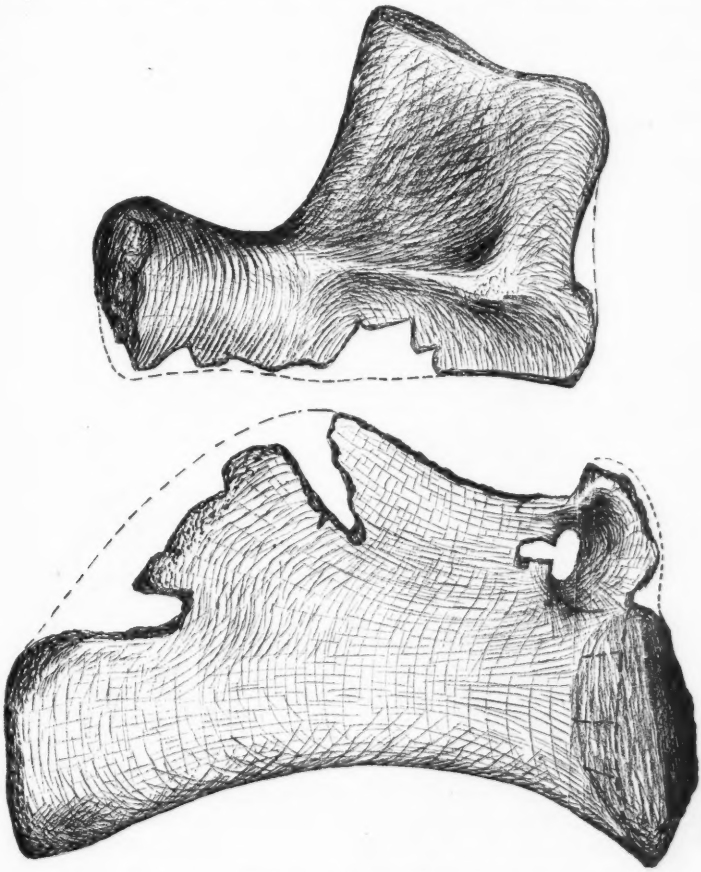


Fig. 10—The right scapula of *Camarasaurus supremus*, external view.

But one species of *Camarasaurus* has as yet been discovered. This I have named *C. supremus*, in allusion to its huge size. The bones, so far discovered by Mr. Lucas, are: a cervical and twenty dorsal and lumbar vertebræ, with twenty caudals. Both scapulæ and coracoids were recovered, with one-half of the sacrum, and two pairs of pelvic bones. Of the hind limb I have the femur, with



Figs. 11, 12.—Pelvic bones of *Camarasaurus supremus*.

a tibia less certainly belonging to the same animal, although found among the other bones. There is one metapodial. There are many other bones which I have not yet reconstructed or determined.

The dimensions of this animal may be inferred from the fact that the cervical vertebra is twenty inches in length and twelve in transverse diameter; and that one of the dorsals measures three and a half feet in the spread of its diapophyses, two and a half feet in elevation, and the centrum thirteen inches in transverse diameter. Another dorsal is two feet ten inches in elevation.

The femur already mentioned is six feet, and the scapula five

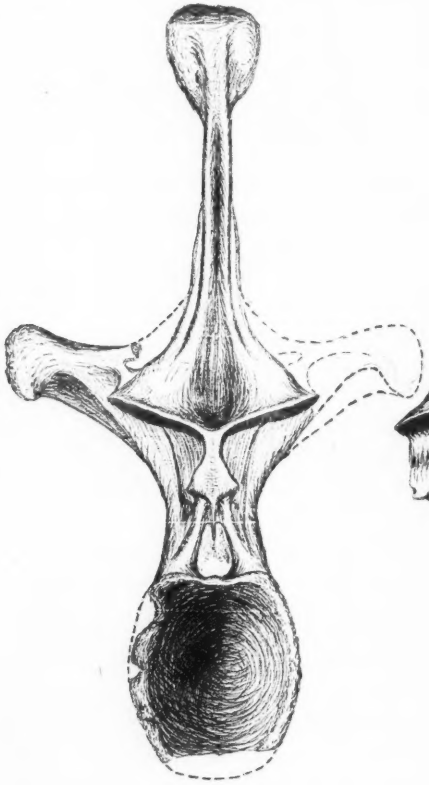


Fig. 13.

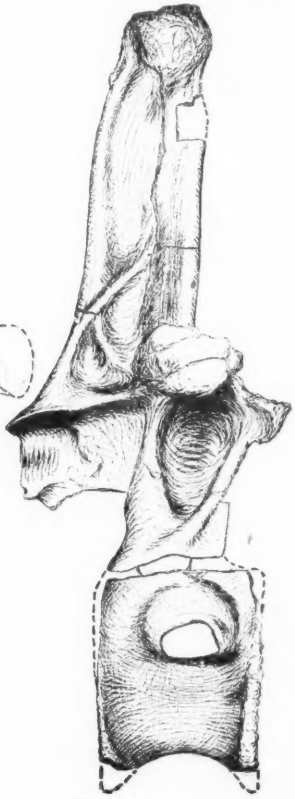


Fig. 14.

Fig. 13—Dorsal vertebra of *Amphicœlias altus* seen from behind, exhibiting the hyposphen.

Fig. 14—The vertebra represented in Fig. 13 seen from the right side, displaying the excavations of the neural arch and spine, and the pneumatic foramen of the centrum.

and a half feet in length. The posterior dorsal vertebræ exceed

in dimensions those of any known saurian, equaling those of the right whale. The centra measure sixteen inches in transverse diameter. The neck was probably ten feet in length.

That this species was capable of and accustomed to progression on land, is certain from the characters of the bones of the limbs and their supports above described. The extraordinary provision for lightening the weight of a portion of the skeleton has more than one significance. It must be borne in mind that the caudal vertebræ retain the solid character seen in those genera which stood habitually on their hind limbs. That the present species was herbivorous is suggested simply by its huge dimensions, and the natural difficulty of supplying itself with animal food.

The scapula is enormous as compared with the pelvic bones. The sacrum is also small and short, showing that the weight was not borne on the hinder limbs. The great length of the humerus in the probably allied genus *Dystrophæus*, from the Trias of Utah, adds to the probability that the same bones were large in *Camarasaurus*. This character, taken in connection with the remarkably long neck possessed by that genus, suggests a resemblance in form and habits between those huge reptiles and the giraffe. While some of the later *Dinosauria* elevated themselves on their hind limbs to reach the tree-tops on which they fed, the general form of the body in some of these earlier types enabled them to reach their food without the anterior limbs leaving the earth.

The vertebræ from all parts of the column of *Camarasaurus* are known, and those of the dorsal and lumbar regions present the extraordinary character, of which a trace is seen in *Cetiosaurus*, of neural spines expanded transversely to the axis of the column. Numerous vertebræ of *Amphicœlias* are known, and in the dorsals in which the neural spine is preserved, the latter displays the usual form, that is, it is compressed in the direction of the axis of the column. The centra differ from those of *Camarasaurus* in the form of their articular extremities, resembling more nearly in this respect the genus *Tichosteus* Cope (Palæontological Bulletin, No. 26, p. 194). They are unequally amphicœlous, the posterior extremity being more concave, and with prominent margins; while the opposite one is less expanded, and is but slightly concave. The neural arch is coössified to the centrum, and there is no capitular costal articulation on the latter.

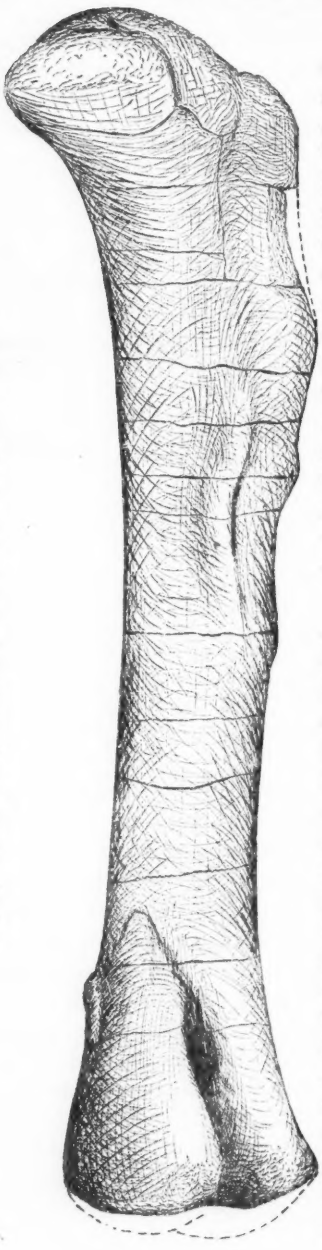


Fig. 15—Femur of *Amphicœlias altus*, seen from the inner posterior direction.

The lightness of construction of the vertebræ of this genus is as remarkable as in the *Camarasaurus*, but is differently exhibited. The greater fore and aft extent is seen in the fossæ, which are therefore not so deeply excavated as in that genus, but the osseous walls are not less lightened and attenuated. The elevation of the middle line of the back must have been extraordinary in the *Amphicœlias altus* (Figs. 13, 14), and the huge knob at the summit of the neural spine indicates the strength of the longitudinal ligament which connected the vertebræ with each other and with the head.

The femur of *Amphicœlias altus* is remarkable for its slender form. It is a few inches longer than that of the *Camarasaurus supremus*, but is not so robust. The shaft is nearly round and somewhat contracted at the middle, where it is slightly convex backwards. It is slightly curved inwards at the great trochanter. Here the shaft is moderately grooved on the posterior face. This trochanter is only a prominent ledge below the head. The third trochanter is situated a little above the middle of the shaft; it is a prominent obtuse ridge directed backwards. The condyles are extended well posteriorly, and are separated by a deep popliteal groove, which originates on the

inferior portion of the shaft. They are also separated anteriorly by a shallow open groove. The external condyle is rather more robust than the internal.

The length of the femur is six feet four inches; the elevation

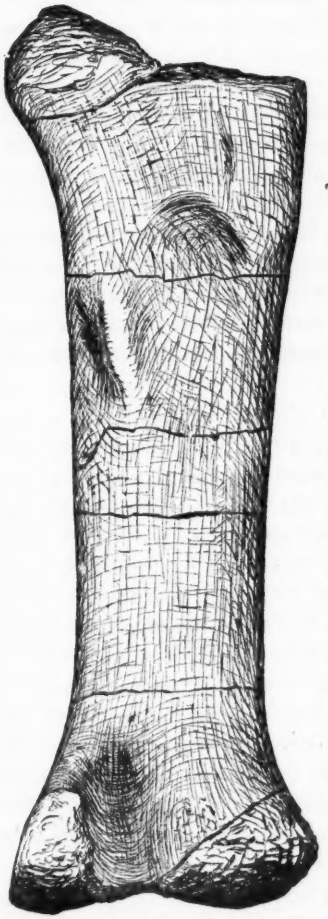
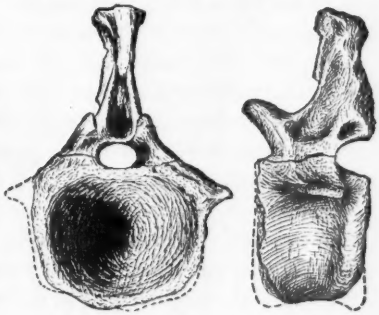


Fig. 17—Left femur of *Amphicœlias latus*, from behind.



a *b*

Fig. 16—A caudal vertebra of *Amphicœlias latus*; *a* from before, *b* from the left side.

of the dorsal vertebra three feet three inches. The animal, if proportioned anteriorly like the *Camarasaurus supremus*, must have been able to elevate itself to a height of thirty feet. Its length cannot yet be conjectured.

If in this fauna, the *Camarasaurus supremus* was preëminent in general proportions, and the *Amphicœlias altus* was the tallest, the *Amphicœlias latus* was the most robust. It is represented in Mr. Lucas' collection by a right femur and four caudal vertebræ which are in good preservation. They reveal the existence of another saurian of huge dimensions, and of great mass in proportion to its height.

The caudal vertebræ are apparently from the anterior part of the series. They are all strongly biconcave; the anterior face more so than the posterior. They are much more deeply bicon-

cave than those of the *Camarasaurus supremus;* and also differ in their relatively and absolutely greater breadth of body.

The femur is extraordinarily robust. The great trochanter is low, but the shaft is widest where it expands outward. The third trochanter is a ridge, is above the middle, and is short and little prominent. It is on the inner edge of the posterior aspect of the shaft, and looks backwards and inwards. The shaft in its present state is compressed so as to reduce the antero-posterior diameter. It is not however crushed or cracked. The condyles have much greater transverse than antero-posterior extent. They are moderately produced backward, and are separated by a deep popliteal groove, while the anterior trochlear groove is wide and well marked. The inner condyle is narrowed posteriorly, while the external one is obtuse and robust. Their articular faces are marked with irregular pits as in *Dystrophæus* and *Cetiosaurus.*

The length of this bone is fifty inches and the thickness fourteen inches. The body of the caudal vertebra is ten inches in transverse diameter.

The character of the articular surfaces of the bones of the limbs already mentioned is a peculiarity of *Camarasaurus* as well as of the genera named. It indicates a thick cartilaginous cap of the bones, which, if ossified, would be an epiphysis like that of the *Mammalia.* I first observed this character in the *Dystrophæus viæmalæ*, a huge saurian discovered by Prof. J. S. Newberry in the red rocks of the Painted Canyon, near the Sierra La Sal, in south-eastern Utah, and described by myself in Lieut Wheeler's final report. The bed from which it was derived is supposed to be of Triassic or Jurassic age. It had an enormous scapula like *Camarasaurus*, and a long straight humerus; its toes were short. It was probably a predecessor of the gigantic forms from the Dakota formation, and an inhabitant of a more ancient continent. It did not reach the dimensions of either of the species of the genus above-named, or of *Amphicœlias*, having been only as large as an elephant.

The genus *Tichosteus* included a species not larger than an alligator. Its vertebræ were hollow, but the internal chamber did not communicate with the body cavity. The only known species of *Symphyrophus* was of similar size, but the vertebral bodies were solid. Some of the numerous crocodile-like teeth found by Mr. Lucas probably belong to species of these genera.

Dr. Hayden visited the locality of Mr. Lucas' excavations, and informs me that the formation from which the *Camarasaurus* was obtained, is the Dakota. Prof. Marsh has attempted to identify what is, according to Prof. Mudge, the same horizon, one hundred miles north of Canyon City, with the Wealden of England. Specimens from the northern locality which I have examined render it certain that the horizon is that of Mr. Lucas' excavations. Of this I may say that there is no palæontological evidence of its identity with the Wealden. The resemblance of the vertebrate fossils to those of the English Oolite is much greater, but not sufficient as yet for identification.

The discovery of *Vertebrata* in the strata of the Dakota epoch is an important addition to the geology and palæontology of North America. Credit is due to Superintendent O. W. Lucas for this discovery, and also in an especial manner for the skill and care he has exercised in taking out and shipping the ponderous specimens.

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THE DISCOLORED WATERS OF THE GULF OF CALIFORNIA.

BY THOS. H. STREETS, M.D., U. S. N.

ONE of the earliest names given by the old Spanish navigators to the body of water that lies between the peninsula of Lower California and the western coast of Northern Mexico was the Vermilion sea. It was also known in the earlier times as the Mar de Cortez, and Mar Laurentano; or the Mar Vermiglion, Mar Rojo, and Mar Vermijo, on account of the reddish color of its waters; and more recently as the Mar, or Gulfo, de California.

The names Vermiglion, Vermijo, and Rojo seem to have been applied as early as between the years 1537 and 1540, after the explorations of Ulloa and Alarcon, and from the accounts given of it by Nuño de Guzman and his officers, who were the conquerors and rulers of Sinaloa, a state bordering on the gulf.

In all these narratives, however, it is well to note that two entirely distinct causes of discoloration are confounded. Father Consag and Ugarte, in particular, speak of the brick-colored corrosive water of the gulf-head, which is altogether different from the more vermilion-colored patches at the mouth of the gulf, which were, doubtless, what suggested the name Vermilion sea.

J. Ross Browne, at a recent date, and before him De Mofras, discredited the statements of the old Spanish sailors, and attributed the red color to the reflection in the water of the brilliant, rosy-tinted clouds of sunset.

We had ample opportunity to verify the truth of the Spanish account during the extended survey of the gulf and its shores by the U. S. Steamer "*Narragansett*," in 1875.

We first saw patches of the red water south of Ciralbo island. The steamer was stopped and a bucket was thrown overboard to secure some of it for examination. The water thus procured revealed nothing when subjected to the test of the microscope; it was perfectly transparent. The failure to discover the cause in this instance was due to the fact that the coloring matter does not float upon the top of the water, but is suspended several feet below; and when this was ascertained, by putting a lead in the bucket and sinking it a half fathom or more below the surface, there was no difficulty in obtaining all that was desired.

When first drawn up and viewed in a glass vessel by the unaided eye the water had a faint reddish tinge. When allowed to stand for a half hour the coloring matter settled to the bottom of the vessel as a greenish-yellow precipitate; and when some of this was taken up by a pipette and examined under the microscope, it was seen to be composed of minute roundish bodies. Further on these were proven to be the remains of ciliate infusoria.

The latter fact was not discovered, however, until after much painstaking investigation. Some small objects had been seen repeatedly to dart across the field of vision when the water was placed fresh upon the glass slide, but they disappeared as they came, like a flash, and it was a long time before their disappearance could be satisfactorily accounted for. The molecules were the only bodies that were permanent, and I was inclined to attribute to them the phenomenon of the water. Finally, one of the little bodies mentioned above stopped directly in the centre of the field of vision, and commenced a rapid rotatory movement, which presently ceased, and the animal was quiescent for a second or two; when lo! a rupture occurred, its molecular contents oozed out, and its transparent envelope became invisible. This then was the solution of the mystery. Afterwards, knowing what to search for, there was no difficulty in seeing the same process repeated again and again.

Mr. Darwin in his "Naturalist's Voyage Around the World," encountered a patch of similarly discolored water off the coast of Peru. According to his account, the water when examined by the microscope was "seen to swarm with minute animalculæ darting about and often exploding. Their shape is oval and contracted in the middle by a ring of vibrating curved cilia. It was, however, very difficult to examine them with care, for almost the instant motion ceased, even while crossing the field of vision, their bodies burst." From the foregoing it is evident that the water of the two localities is discolored alike by the same cause.

Those from the Gulf of California exhibited the same rapid to and fro motion as the ones seen by Darwin, and this motion was succeeded by a rotatory movement on the longer axis. Sometimes the rupture took place as soon as the latter motion ceased, and at other times the animal was motionless for a few moments preceding its final dissolution; and it was during these intervals of quiescence, only now and then observed, that anything like a correct impression of its general outline and structure could be gained. The following is the result of numerous observations extending over considerable time. The animal is oval in outline, with a projecting lip at its broad extremity, fringed with cilia. The rotatory movement took place around the smaller end as a pivot, and it advanced the same end in its to and fro movements. The envelope is a transparent and, apparently, structureless membrane, and in its interior are greenish-yellow granules, or bodies with dark rims and bright centres. These bodies floated loosely in the cavity of the animal, for when it revolved they changed their places like pebbles in a revolving cask. They averaged about the 1–12000 of an inch in diameter.

According to Mr. Darwin the bursting, which generally occurred at the extremities of the body, is due to an expansion of the tegumentary covering. I can not reconcile this with the results of my own observations. On the contrary, I noticed a contraction to take place in the transverse axis of the body; its length was increased and its transverse diameter diminished; in other words, the oval form was replaced by an oblong. This will better illustrate why the rupture generally took place at one of the extremities of the body. If these observations are correct the bursting of the envelope would be the result of an active rather than a passive action. The only reasonable way of accounting for an

expansion of the body-covering would be by an imbibition of water from the outside, and a rupture would as likely occur in one place as in another in such a case.

When confined in a drop of water, or in an animalcula cage, the little animals never lived as long as a minute, the field of vision was often strewn with their remains before the observer had time to look through the tube of the microscope. This was especially the case if some time had elapsed since their removal from the sea. When kept in a bucket or in any vessel containing a large quantity of water they lived for a much longer time.

Many experiments were made with destructive agents with the view of killing the animalculæ before they had time to destroy themselves, but the results were unsatisfactory. In every instance they failed to accomplish the end for which they were used; if they served any purpose it was to accelerate the process of self-destruction.

The only explanation that I can give for this suicidal propensity lies in the abstraction of oxygen from the water; yet this appears somewhat exceptional in view of the fact that this gas is rather immaterial to the existence of the low, structureless forms of animal life. The bacteria, for instance, will flourish in infusions that have been boiled and hermetically sealed.

We have a record of these minute animals having been in this locality for more than three hundred years, defying the combined action of the winds, waves, and currents, and remaining as closely aggregated as a community of individuals endowed with reason or instinct, and not exposed to dispersing causes. They apparently have great control over their movements, at least so far as regards the fixity of their positions.

The great Colorado River, at the head of the gulf, constantly pours into it an immense volume of water which has a tendency to carry things seaward, as it does logs and other drift; yet here is this microscopic animal, the 1-1000 of an inch long, exposed to the same influence, but remaining in its chosen locality for centuries. What keeps these masses together forever in one place in spite of the circulation of the waters on the surface of the earth? Well might the question have presented itself to the mind of Darwin, but his fertile imagination suggested no adequate solution for it.

Other patches of discolored water obey the same impulse. In

1835 Mr. Darwin investigated that off the coast of Peru. The earliest notice we have of its existence in that locality is the beginning of the nineteenth century, and a good authority might be cited for its existence there as late as 1872. In the latter year while sailing down the eastern coast of South America we passed through a tract, while off the mouth of the Rio de la Plata, where the surface of the water was covered with a thick scum, resembling saw-dust. Darwin, in 1832, or forty years previous, found it further north, in the vicinity of the Abrolhos Islets. In this case the material that discolors the water belongs to the vegetable kingdom. It is a "minute cylindrical conferva," the *Trichodesmium erythræum*. According to Ehrenberg, the color of the water of the Red Sea is due to the presence of a "peculiar genus of alga," and Darwin states, on another authority, that it is the same species as that found off the coast of Brazil. In the latter locality it would certainly argue a defect of the vision to call the water red. Old sailors call it whales' feed, which, with them, is the generic title of everything that discolors the water of the ocean.

"The brick-colored and corrosive waters of certain parts of the gulf-head" received an easier solution at our hands than the more vermilion patches of the mouth of the gulf. The former is spoken of as being so extremely caustic as to remove the skin from the body like a blister, and to cause obstinate boils and ulcers, similar to those produced by scurvy, and which lasted for a long time. Some have gone so far as to even state that it would rot the clothes of those who were incautious in meddling with it. A recent compiler has endeavored to account for this peculiar property of the water on the supposition of an "excess of the iodides, bromides and sulphurets of minerals, derived, doubtless, from the abundance of volcanic material so common in these portions of the gulf." But as is common in such cases of explanatory guessing, his answer is not the true one.

Most of our information concerning this water has come down to us with the accounts of the voyages of Father Consag and Ugarte, both of whom confined their explorations, in these parts, to the head waters of the gulf; the former in 1746, and the latter in 1721.

We encountered this peculiar caustic water in about the same locality assigned it by Consag and others. In the Bay of Muleje, an indentation in the coast more than half way up the peninsula,

the whole surface of the water was of a milky-red color. The body that gives to this water the strangely caustic properties is not a mineral, but an animal—a flagellate infusorium—the common *Noctiluca miliaris*. In this well-sheltered bay they accumulate from their light specific gravity at the top of the water. How thick the stratum was we did not ascertain, but we may form some idea of its extent from the fact that we steamed through the tract in a straight line for four or five hours at a speed of about five knots per hour. We dipped a canvas bucket in their midst, and when the water drained off it remained half filled with the animalculæ. They resemble minute grains of boiled sago. Every drop of water was literally crowded with them. They were so small that it required two or three to cover the area of a pin's head. It is very easy to comprehend how, if this bay were agitated by the slightest cause, it would glow as a broad sheet of living fire.

The Spanish sailors bathed in this water, and according to their chroniclers their bodies were covered with boils and ulcers in consequence. They were only half-way right when they attributed their infirmities to the water. The lashes of the little *noctiluca* were, undoubtedly, the exciting agents—the direct cause of their troubles; but that they were insufficient, in themselves, to account for the severity of the symptoms the evidence of our own men under different conditions of bodily health sufficiently proves. That their ulcers were similar to the effects of scurvy they recognized; and that a scorbutic condition of the blood played an important part in their production is evident. All sailors in those days were more or less the subjects of scurvy, which was a greater obstacle to the spread of commerce than were the small crafts of the navigators. It is a disease that often manifests itself in the form of boils and ulcers, and it exaggerates all trivial bruises and injuries of the skin. If our own sailors had been scorbutic when they bathed in the water the same train of symptoms would undoubtedly have followed; and, as it was, the skin, in places, became considerably inflamed and swollen, but the only disagreeable symptoms were the burning and tingling that accompanied the inflammation, which was of short duration.

NOTES ON THE DISTRIBUTION OF TIMBER IN SOUTH-WESTERN IOWA, WITH INFERENCES CONCERNING THE ORIGIN OF PRAIRIES.[1]

BY PROF. J. E. TODD.

UPON the bluff deposit of Western Iowa is found an unusually favorable field for testing the theories concerning the much-vexed question of the origin of prairies, or rather the origin of forests, for doubtless the former are necessarily the older conditions of most regions.

The soil over wide areas is almost perfectly uniform, and so deep that no underlying formation can thrust in its influence to complicate the problem. The surface is almost infinitely varied; the high plain which is the summit of the loess, the low alluvial plains and hill-sides and bluff-sides presenting every conceivable angle of inclination, and dipping in every possible direction. To produce even greater variety, ledges of rock and knolls of gravel occasionally appear.

I.

In such a region timber occurs in the following circumstances:

(1.) In the hill-regions where the slopes are inclined from 5° to 10°, it is found much the most generally on the northern slopes just south of creeks flowing east or west. This was noted some years since, by Mr. J. A. Allen.

Timber is found in the same region a little less frequently on western slopes, east of creeks flowing north or south. On the same streams considerable timber may occasionally be found on the west side. All other portions of the hill region are uniformly destitute of trees.

(2.) In the bluff region, where the slopes are from 10° to 45°, just east of the bottom lands of the Missouri river, timber is found over most of the surface, forming a belt from one to five miles in width, in Fremont county, and extending northward through Mills and Pottawattamie counties, with a narrowing and more interrupted course till it fades out in Harrison county. This belt is usually bounded on the west by the crest of the most western ridge of bluffs, leaving the slopes facing the bottom land bare, except in two well-marked cases; the first, when a lake,

[1] Read before the Iowa Academy of Science, September 26, 1877.

slough or stream comes close to the base of the bluffs; the second, when the bluff-side is deeply furrowed with ravines. In the former case the slopes are covered with bushes and scrub-oaks, often quite to the top. In the latter, the ravines are wooded, usually with the trees extending considerably higher on the south side than upon the north, and often the latter is scarcely wooded at all. These points are very evident to one riding over the bottom lands so far away as to get a general view.

(3.) In the low alluvial valleys, the timber is found along the streams, usually in narrow strips, widening to fill the bends, and usually wider on the east and north sides of the stream. All other portions of the bottom lands are remarkably destitute of trees and bushes.

II.

The timbered areas are very constant, increasing very slowly if at all. This is indicated by the existence of old trees, over two hundred years old, within four or five rods of prairie, and the prairie showing no signs of having been previously timbered. Some of these cases were on the north side of groves, which side is most exposed to prairie fires, as the north-west wind usually prevails when the prairies are burning. Moreover after a personal acquaintance for the past twenty-five years with numerous localities in this region where the annual fires have been kept out, the writer has not yet learned of a single case where the advance of the timber has been more than five rods, and in the great majority of cases it has not been as many feet. He has not noted any cases of any destruction of timber by prairie fires except on the bottom lands, where the grass is much more rank and the timber is not protected by outlying hazel thickets as upon the upland.

Almost the only gain of timber land is due to seeds of the cotton-wood and willow finding lodgment on the bare surface of sand bars, "break offs," and where freshets break the turf, or cover it with a layer of bare earth. From such beginnings sometimes thrifty groves result, but quite as frequently the trees so started barely hold their own against their herbaceous foes, if not assisted by the favoring hand of man. In the slow advance of groves before alluded to, the *Rhus glabra* takes the front rank, and the hazel follows, preparing the way for elms, hickories, etc.

III.

These are the observed facts; what is their bearing on some of the theories advanced by different writers?

(1.) We find in Dr. White's report on the Geology of Iowa, Vol. 1, page 133, these words: "It now remains to say without the least hesitation that *the real cause of the present existence of the prairies in Iowa is the prevalence of annual fires.* If these had been prevented fifty years ago, Iowa would now be a timbered, instead of a prairie state. This view was fully endorsed by his assistant, Professor St. John. Although the distribution of trees as given above may seem to favor this theory, when we remember that fires occur mainly while the north-west winds prevail, and though it may be a slight factor in the problem, yet its inadequacy is clearly proved, not only by the constancy of timber areas whether the fires burn or not, but also indirectly, by their failing to make prairies of Ohio and New York, when the principle is made of general application. Dr. Newberry from a general survey of the subject, pronounces the idea "simply puerile" (Geology of Ohio, Vol. 1, page 30).

(2.) Professor J. D. Whitney has recently taken pains to reiterate his theory published some years ago, viz: that the cause of prairies, at least in states east of the Missouri river, is mainly in the fineness and depth of the soil, which he further ascribes to the nature and position of the rocks underlying. This theory is sufficiently disproved by the observations given above. In exactly the same soil totally different results are discovered.

(3.) The theory that the absence of trees is mainly dependent on the rain-fall, as is very generally held, is also proved to be faulty, if not false, for there is every reason to believe the rain-fall the same over most of the area under consideration. There may be an excess in the main bottom lands, but surely not on either side of the same ravine or hollow. This theory is also disproved most clearly by Professor Whitney in his article in the AMERICAN NATURALIST (October, 1876), in which he shows from Smithsonian rain-charts that the forest region of several States receives the least rain-fall, and the prairie region the greatest.

(4.) The theory advocated, as we understand, by Colonel J. W. Foster, and more recently by Dr. Newberry (Geology of Ohio, Vol. 1, page 30), is, that forests to flourish need "not so much a profuse as a constant supply of water," that a *deficiency* of *winter*

rains and snow with "occasional though rare seasons of excessive dryness" characterize the prairie regions. This seems to come nearer explaining general facts, but though the underlying cause may be correct, viz: *constant moisture*, the means by which it is secured is certainly not that needed to explain the particular cases before us, for both timber and prairie, in the region under consideration, has, as before stated, the same rains and the same droughts.

IV.

From these theories, then, we have found nothing helpful for solving our problems, unless it be the idea of the *constancy of moisture*. Furthermore it seems quite clear that there is nothing very variable in the region observed, except the surface of the land and the distribution of streams. Can these factors secure the constancy of moisture required, in the circumstances where we have found trees, and the lack of such constancy where we do not find them? Let us see.

(1.) This constancy of moisture must be in one or both the *media*, in which the trees are located, viz: the soil and the air, and it is reasonable to presume that this constancy is to be looked for when the forces of vegetable life are in activity. Excess or lack of moisture at other times may be safely ignored.

(2.) We can readily see that moisture of the soil will be more constant on northern slopes than southern, because they are not so much exposed to the sun's heat. In spring they are many days later in drying up, so also after showers, and at certain degrees of humidity of the air, the northern slope may act as a *condenser*, thus collecting the moisture, which the opposite hill-side is giving off. These processes also affect the air, tending to secure a greater constancy on the northern slope. Moreover the same slope would be more protected, by its position, from the summer south wind, which occasionally is very hot and dry. These considerations may sufficiently account for the timber occurring on northern slopes and for its absence, in general, from southern slopes.

(3.) The prevailing winds of the region are westerly in spring and summer. This perhaps may sufficiently explain the preponderance of timber areas on the east side of streams flowing south, especially where the streams are of considerable size, and affording better opportunity for evaporation. This

combined with the increased roughness of the surface of the country, may also go far toward explaining the timber belt observed in the bluff region. This becomes more obvious when we remember that the east side of the Missouri bottom lands, in the particular counties through which the timber belt passes, abound in sloughs and lakes, which are kept well filled by numerous springs and small streams, which fail to make their way across the bottom land to the river.

These causes also explain the occurrence of timber on the west face of the bluffs, where the moisture in the air counteracts the severe drainage of the abrupt slope and the intense drying action of the afternoon sun, which render other portions of the bluff-face almost destitute of even grass.

(4.) It remains to explain, if possible, the distribution of timber and prairie in the alluvial valleys or bottom lands. Here we have usually a slightly different soil, layers of clay preventing the ready drainage of many parts. These conditions render much of the surface too wet at all times, while other places are too wet in spring and too dry in late summer. These areas are found mostly in the eastern portion of the Missouri river bottom, because the surface there is lower and receives the water from springs and freshets from the bluff-region. The occurrence of trees along the streams and on ridges along old channels, on the other hand, may be explained partially by the inequality of surface, making the drainage of surplus water possible, so that moisture around the roots is more constant than elsewhere on the bottoms. The prairie fires, moreover, have been more efficient over the dryer portions of the bottom lands than elsewhere, because of the greater growth of grass and the free sweep for winds north and south.

V.

That the *constancy of the humidity of air and soil* is the most important factor in the formation of forests seems supported by further considerations taken from a wider field, which may be briefly indicated as follows: This theory explains the timber in areas of less rain-fall in northern Michigan and Wisconsin by their being traversed by moist winds, and not as subject to the hot rays of the sun as the southern portions of the same states. It explains the occurrence of timber upon mountains by a substitution of altitude for latitude in the preceding cases. It

explains the distribution of timber in slightly hilly and level regions like the one under consideration, as has been shown above. It explains the existence of prairies where the rain-fall may be extreme even, for the precipitation of moisture may be caused by extreme changes of temperature, and the changeable climate which may produce much rain may also produce intervals of great dryness. It explains why the timber areas may sometimes correspond to geological formations, as urged by Professor Whitney. The soil either carrying the rain-fall away rapidly or retaining it; either cutting off the surface from the springs of water below, or drawing it up like a sponge; either rendering the climate more uniform by its better conducting power, or allowing the changes of the atmosphere to govern too perfectly the temperature of the surface of the ground. It may explain to some degree the fact that the grass of the prairie prevents the advance of timber in a hilly region by its preventing the showers entering and moistening the roots of larger forms of vegetable life. It also suggests certain means for securing the healthy and continued growth of groves, indicating the more favorable positions for them, showing methods of economizing the rain-fall in places where it may be scanty, etc.

In conclusion, therefore, while acknowledging that prairie fires, the amount and distribution of rain-fall, the nature of the soil, the temperature and inclination of surface, that all may have more or less importance in explaining the origin of forests and prairies; we may nevertheless be convinced that the *fundamental condition of forest growth is a constant medium humidity of air and soil.* Let us, therefore, *while not neglecting our pluviometers look more carefully to our hygrometers* in our study of this subject.

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THE FIELD-WORK OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, UNDER THE DIRECTION OF PROF. F. V. HAYDEN, FOR THE SEASON OF 1877.

ON the completion of the survey of Colorado last year, it was determined that the work of the United States Geological and Geographical Survey of the Territories, under the direction of Prof. Hayden should continue northward into Wyoming and Idaho. The belt of country including the Pacific Railroad having been explored

and mapped in detail by the Survey of the Fortieth Parallel, under Clarence King, Esq., it was deemed best to commence at the northern line of that work, and continue northward and westward, taking for the season of 1877 the country from Fort Steele, Wyoming Territory, to Ogden, Utah, or, more exactly, from longitude 107° to 112°, and northward to the Yellowstone Park.

The primary-triangulation party, in charge of Mr. A. D. Wilson, chief topographer of the survey, took the field from Rawlins Springs, W. T. Near this point a base-line was measured with great accuracy, from which a net-work of triangles was extended over the country to the north and west, locating at intervals of from twenty to thirty miles, some prominent peaks upon which stone monuments were built, in order that the topographers could recognize the points thus fixed for them. Upon these points was based the system of secondary triangulation.

From the base at Rawlins, the work was carried northward to the Sweetwater mountains, and thence to the Wind River range. Upon some of the more prominent peaks of the latter range, such as Frémont's peak, the stations were made with much difficulty, owing to the great masses of snow found there during the month of June, when the party was working. From this range the work was carried across the Green River basin to the mountains on the west and north, where several stations were made. The work was resumed to the west as far as Fort Hall, Idaho, and thence south to the vicinity of Bear lake, where another base, or base of verification, was measured; thence south as far as Ogden and Evanston, connecting with the triangulation of the Fortieth Parallel Survey at these points. From Evanston the party marched eastward, making some stations north of the railroad, thus bringing the work back to the point of beginning, Rawlins Springs, where the party was disbanded for the season.

The area assigned to the Green River division, under the direction of Mr. Henry Gannett, was rectangle No. 56, which is limited on the east and west by the meridians of 109° 30′ and 112°, and on the north and south by the parallels of 43° and 41° 45′. This is an area of about 11,000 square miles, lying in parts of Wyoming, Utah and Idaho. The party took the field at Green River city, Wyoming, on June 1st. They first surveyed the drainage of Green River basin. For this purpose they travelled up the Big

Sandy, a large eastern branch of the Green, to the foot of the Wind River mountains; thence crossing the head of the basin, fording the large and rapidly rising streams which make up the New Fork of the Green, they reached the main Green, and traveled down its western bank, going in to Granger, Wyoming, on the Union Pacific Railroad, for supplies on June 23d.

The party left the field at Ogden, Utah, on September 30th, having been in the field just four months. The area surveyed was between 12,000 and 13,000 square miles; 347 stations and locations were made, 53 of the stations being important ones, were marked with stone monuments for future reference.

The geological work of Dr. A. C. Peale in the Green River district connected directly with the western edge of the Sweetwater district. With the exception of a small area of granite along the south-western side of the Wind River mountains, and some basaltic flows in the north-western portion of the district, the rocks are sedimentary, including the rocks from the Silurian to very late Tertiary age.

The first month of the season was occupied mainly with the survey of the Green River basin.

The next area taken up was that lying between Green river and the Bear, with a strip along the northern edge of the district, reaching westward beyond Fort Hall.

The Blackfoot, Portneuf, and Bear all have basalt in their valleys. On the Portneuf it extends almost to the Snake River plain, appearing as a narrow belt. Its surface slopes, but not so much as the present bed of the stream. In some places the volcanic rock appears to have pushed the river to the western side of the valley. The lower valley of the Portneuf is interesting from the fact that it is the probable ancient outlet of the great lake that once filled the Salt Lake basin. At the head of Marsh creek, which occupies the valley, continuing directly south from that of the Lower Portneuf, is the lowest pass between the Great Basin and the drainage of the Columbia. In fact, so low and flat is it that a marsh directly connects the two streams, one flowing to the Bear and the other to the Portneuf and Snake rivers.

The bend of Bear river at Soda springs is one of the most remarkable features of the whole district. Rising in the Uintah mountains, Bear river flows northward for over two hundred miles, and at Soda springs bends abruptly and flows southward

toward Salt lake. After it emerges from the gap west of Soda springs, it flows out into a wide valley which opens directly into that of the Upper Portneuf. In this valley the divide between the two rivers is only a basalt plain, and in the eruption of this lava we may look for the clew to the extraordinary course of Bear river.

The latter half of the season was devoted to Bear river, Bear lake, and Cache and Malade valleys.

There is but little doubt that the waters which once filled the Salt Lake basin covered also the broad Cache valley. The modern tertiary deposits are found jutting against the mountains, and seem to pass gradually into the more recent deposits found in the central portion of the valley. The clays, sands and marls of these modern beds are beautifully exposed along Bear river, which cuts its way across the north-western part of the valley. On the west the mountains are broken or isolated ranges, which seem to have risen above the waters of the old lake as islands. The terraces are well marked on their sides, connecting with the Salt Lake valley through the gap of Bear river.

West of this gap, and extending northward, is the Malade valley. It is broad and filled with modern lake deposits. Silurian rocks outcrop on the east and Carboniferous on the west. At the divide between the Malade and Marsh creek is another of the old outlets of the ancient Salt lake when its waters were at the highest level. Although the area surveyed was large (13,000 square miles), good collections of fossils were made and data obtained for the elucidation of many interesting problems in relation to the age of the mountains.

Dr. F. M. Endlich, geologist of the Sweetwater divison, states that within the area described above he found a well diversified country. A portion of the Wind River mountains in the north-west corner, the Sweetwater and Seminole hills toward the eastward, in addition to the lower bluff-country in the southern portion, furnished material at once full of interest to the student and to the surveyor.

On July 5th the party left Stambaugh and marched toward the low valleys belonging to the Wind River drainage. The difference in elevation amounted to about 3,000 feet, and the temperature of the atmosphere was consequently much higher. With the change of elevation the geological formations change. Instead of the youngest

beds resting directly upon metamorphics, we now find a full series of the sedimentary formations, beginning with the Silurian. Numerous interesting stratigraphical phenomena were observed and studied with a view to determine their relations to the main mountain-chain. An ample amount of evidence has been obtained, more particularly by this means, to speak positively respecting the geological age of the Wind River mountains. These latter, in this region, form the main Rocky Mountain chain, and the determination of their age will necessarily throw much light upon the same question arising in other portions of the same range. It will be possible to speak with a certain degree of precision of either the local, varying (as to time) elevation of the mountains or to refer it to one particular epoch for the distance of many hundreds of miles.

Camp Brown is located in the valley of the Little Wind river, which there is of considerable breadth. The famous hot springs there were examined. As the main peaks of the Wind River mountains were mostly inaccessible from the east side, it was deemed advisable to make the ascents of the highest from the west. Therefore the party traveled along the eastern foot-hills, through a very rugged country, until Stambaugh was reached.

July 22d the party again left Stambaugh and marched along the headwaters first of Sweetwater river and then of the eastern tributaries of Green river. Several of the highest peaks were ascended, and the greatest altitude reached found to be about 13,700 feet. This latter was on what the settlers generally designate as Frémont's Peak. From careful comparison of Frémont's report with the observations made by the party, it is evident that a misapplication of the name has been made, and that the peak in question is not the one ascended by that intrepid explorer of an "early day."

Having reached the northern limit of the district, the route was reversed and the western foot-hills of the main ranges examined. Here, as well as in the mountains proper, were noticed the remains of enormous ancient glaciers. Moraines, covering many square miles, often a thousand feet in thickness, extend downward through narrow valleys, now containing rushing streams. Striation, grooving and mirror-like polish of rock *in situ* denote the course taken by the moving ice-fields that have left these marks of their former existence. From all appearance the cessa-

tion of glacial activity must have occurred within a comparatively recent time. Scarcely any vegetation has sprung up on the light glacial soil, and the characteristic distribution of erratic material bears every evidence of freshness. Considering the enormous amount of snow and ice that was observed by the party exploring (latter part of July and beginning of August), the view was expressed by the geologist that the discovery of still active glaciers in that range would by no means be surprising.

Returning for the last time to Stambaugh, the route was taken in an easterly direction along the Sweetwater and its drainage. First, the adjacent drainage of the Wind river was surveyed, and the divide between the two streams crossed. All along the Sweetwater the characteristic "Sweetwater group" of tertiary age was found to occur. It has been named and described in my former publications. This continued uninterruptedly until a series of hills north of the river opposite Seminole Pass, was reached. These consist merely in projections of granite that during the tertiary epoch, and probably long before that, had remained as islands above a widely-extended sea. Apart from their singularly unique character in this respect, the granite itself possesses a peculiarity that renders it at once conspicuous. Owing to the distribution of component minerals this granite is in a high degree subject to exfoliation. Probably the main cause of this may be found in the action of freezing water. The result as observed is striking. Instead of the rugged outlines usually presented by isolated granitic outcrops, we find a series of rounded, smooth, almost totally barren hills. To such an extent is this feature developed that many of them offer serious obstacles to an attempted ascent. A locality where the celebrated moss-agates occurred in great quantities was found in that region, and the geognostic horizon of these interesting quartz varieties was established.

The district assigned to the Teton division, directed by Mr. G. R. Bechler, was situated between the parallels 43° and 44° 15′ of north latitude and the meridians 109° and 112° of west longitude. This area is drained by the branches of Shoshone or Snake river. The first portion surveyed by this division lies along the Blackfoot river and its tributaries.

After having completed the area described above, Mr. Bechler returned to Fort Hall for supplies, and then passed up Henry's

Fork to the northern portion of the Teton mountains, where he spent several weeks investigating this snow-covered range; then, crossing Pierre's basin, surveyed the lofty group to which in 1872 he gave the name of Pierre's Hole mountains. These ranges are characterized by as great ruggedness and inaccessibility as any other mountains in the north-west.

Fronting the Grosventre range on the north rises another mountain cluster, separated from the former by the Grosventre river. This range forms the divide between the latter river and the Buffalo Fork of the Snake. It connects with the main Rocky mountains near the sources of Wind and Gosventre rivers and the Buffalo Fork of the Snake, and culminates near its western end in Mount Leidy. Mr. Bechler occupied two weeks in a careful survey of a part of the Grosventre range, the entire Mount Leidy group, with the Upper Snake River valley and its numerous interesting features.

North of the Buffalo Fork of the Snake, his observations extended into that densely wooded mountain region which connects to the north with the Mount Sheridan group near the Yellowstone, Lewis and Shoshone lakes.

About the 1st of September he left the waters of Snake river and marched along the rugged and densely timbered mountain spurs toward the Upper Wind River pass, and, after crossing the latter, entered Wind River valley, having the Owl mountains on the left and the Wind River range on the right. As he was about to cross over the Warm Spring pass of the Wind River mountains into the Green River valley to survey the southern ends of the Grosventre and Salt River ranges, he received a notice through Indian scouts, from the commander of the military post at Camp Brown, to leave the country on account of the danger of hostile Indians. On this account nearly a month of valuable time was lost, abridging somewhat the results of the season's work. Notwithstanding the various difficulties which this party encountered, they surveyed an area of about 6,000 square miles of the most rugged mountain country in the north-west, and made one hundred and ten reliable observations with the mercurial barometer. Mr. Bechler, throughout his district, personally observed 7,340 horizontal angles and 5,700 angles of elevation and depression; they repeated backward and forward, and were checked by good barometric observations.

Mr. Orestes St. John, geologist of the Teton division, entering the field assigned to the Teton division of the survey at its southwestern corner, the first five weeks were devoted to the examination of the region lying in the great northern bend of the Snake river, and which includes an area of 1,700 to 2,000 square miles.

The Blackfoot mountains are mainly composed of Carboniferous strata, which mainly represent the earlier period, whose epochs are indicated by similar palæontological peculiarities which distinguish the Lower Carboniferous formations in the Mississippi basin, and which more extended research will doubtless reveal in this distant region. But one of the most interesting discoveries in this connection was the presence of fish-remains, representing several forms identical with or closely allied to Keokuk species of the genera *Cladodus*, *Petalodus*, *Antliodus*, *Helodus*.

Dr. White, the palæontologist of the survey, has shown the identity of the lignitic series of strata east of the Rocky mountains in Colorado with the Fort Union group of the Upper Missouri river, and also its identity with the great Laramie group of the Green River basin and other portions of the region west of the Rocky mountains. He also finds the planes of demarkation between any of the Mesozoic and Cenozoic groups, from the Dakota to the Bridger inclusive, to be either very obscure or indefinable; showing that whatever catastrophal or secular changes took place elsewhere during all that time, sedimentation was probably continuous in what is now that part of the continent from the earliest to the latest of the epochs just named. Other results and further details of the season's work will appear in the following paragraphs.

The general course of travel pursued by Dr. White during the season was as follows, not including the numerous detours, meanderings and side trips which the work necessitated: Outfitting at Cheyenne, he journeyed southward, traversing in various directions a portion of the great plains which lie immediately adjacent to the eastern base of the Rocky mountains in Colorado. The most easterly point thus reached was some sixty miles east of the base of the mountains and the most southerly point about twenty-five miles south of Denver. Returning to Denver to renew his outfit, he crossed the Rocky mountains by way of Boulder pass through Middle park. After making certain com-

parative examinations of the Mesozoic and Cenozoic formations in Middle park he proceeded westward to the headwaters of the Yampa river, following that stream down to the western foot-hills of the Park range of mountains.

Here resuming his comparative examinations of the Mesozoic and Cenozoic strata, he passed down the valley of the Yampa as far as Yampa mountain, one of those peculiar and remarkable upthrusts of Palæozoic rocks through Mesozoic strata. In all this area, as well as that between the Yampa and White rivers, the Laramie group reaches a very great and characteristic development, and it received careful investigation, yielding some of the most important results of the season's work. Crossing the ground between the two rivers named to White River Indian agency, thence down White River valley about one hundred miles; thence to Green river, crossing it at the southern base of the Uintah mountains, making many detours on the way, he reviewed the geology of the region which he had surveyed during the previous season. This review brought out not only the important palæontological facts before referred to, but it also added materially to the elucidation of the geological structure of the region which lies between the eastern end of the Uintah mountain range on the west and the Park range on the east.

Beyond Green river he pursued his travels westward, studying the Mesozoic and Cenozoic strata that flank the Uintah range upon its south side, and making comparisons of both their lithological and palæontological characteristics.

In this way he traversed the whole length of the Uintah range, crossing at its junction with the Wasatch range over into the valley of Great Salt lake. Recrossing the Wasatch to the north side of the Uintah range he continued his examinations of the Cretaceous and Tertiary strata into and entirely across the great Green River basin, leaving the field at the close of the season at Rawlins station on the Union Pacific railroad.

A general statement of the results of the season's work has been given in a previous paragraph, but the following additional summary will make the statement somewhat clearer, being made after the route of the season's travel had been indicated. The formations of later Mesozoic and earlier Cenozoic ages, especially those to which Dr. White in former publications, has applied the provisional designation of "Post-Cretaceous," have received par-

ticular attention. The extensive explorations of Dr. Hayden in former years, and the palæontological investigations of the late Mr. Meek, pointed strongly to the equivalency of the Fort Union beds of the Upper Missouri river with the lignitic formation as it exists along the base of the Rocky mountains in Colorado, and also to the equivalency of the latter with the Bitter Creek series west of the Rocky mountains. The investigations of this year have fully confirmed these views by the discovery not merely of one or two doubtful species common to the strata of each of these regions, but by an identical molluscan fauna ranging through the whole series in each of the regions named.

This shows that the strata just referred to all belong to one well-marked period of geological time, to the strata of which Mr. King has applied the name of "Laramie group" (Point of Rocks group of Powell). His investigations also show that the strata, which in former reports by himself and Professor Powell have been referred to the base of the Wasatch group, also belong to the Laramie group and not to the Wasatch. He has reached this later conclusion not merely because there is a similarity of type in the fossils obtained from the various strata of the Laramie group with those that were before in question, but by the specific identity of many fossils that range from the base of the Laramie group up into and through the strata that were formerly referred to the base of the Wasatch. Furthermore, some of these species are found in the Laramie strata on both sides of the Rocky mountains. Thus the vertical range of some of these species is no less than three thousand feet, and their present known geographical range more than a thousand miles.

Besides the recognition of the unity of the widely-distributed members of the formation of this great geological period, bounded by those of undoubted Cretaceous age below and those of equally undoubted Tertiary age above, his further observations have left comparatively little doubt that the "Lake Beds" of Dr. Hayden, as seen in Middle Park, the "Brown's Park group" of Professor Powell, and the "Uintah group" of Mr. King, all belong to one and the same epoch, later than and distinctly separate from the Bridger group.

In that portion of the region which lies adjacent to the southern base of the Uintah Mountain range, and which is traversed by Lake fork and the Du Chesne river, not only the Uintah group,

but both the Green River and Bridger groups also are well developed, each possessing all its peculiar and usual characteristics as seen at the typical localities in the great Green River basin, north of the Uintah mountains. This, added to the known existence of Bridger strata in White River valley, and the extensive area occupied by the Green River group between White and Grand rivers, has added very largely to our knowledge of the southward extension of those formations.

In all the comparative examinations of the formations or groups of strata that have just been indicated, he has paid especial attention to their boundaries, or planes of demarkation, crossing and recrossing them wherever opportunity offered, noting carefully every change of both lithological and palæontological characters. While he has been able to recognize with satisfactory clearness the three principal groups of Cretaceous strata, namely, the Dakota, Colorado, and Fox hills, on both sides of the Rocky and Uintah mountains, respectively, they evidently constitute an unbroken series, so far as their origin by continuous sedimentation is concerned. While each of the groups possesses its own peculiar palæontological characteristics, it is also true that certain species pass beyond the recognized boundaries of each within the series.

The stratigraphical plane of demarkation between the Fox hills, the uppermost of the undoubted Cretaceous groups, and the Laramie group, the so-called Post-Cretaceous, is equally obscure; but the two groups are palæontologically very distinct, inasmuch as the former is of marine origin, while the latter, so far as is now known, contains only brackish-water and fresh-water invertebrate forms. He reports a similar obscurity, or absence of a stratigraphical plane of demarkation, between the Laramie and Wasatch groups, although it is there that the final change from brackish to entirely fresh water took place over that great region. Furthermore, he finds that while the three principal groups of the fresh-water Tertiary series west of the Rocky mountains, namely, the Wasatch, Green river, and Bridger groups, have each peculiar characteristics, and are recognizable with satisfactory distinctness as general divisions, they really constitute a continuous series of strata, not separated by sharply-defined planes of demarkation, either stratigraphical or palæontological.

Messrs. S. H. Scudder, of Cambridge, and F. C. Bowditch, of

Boston, spent two months in Colorado, Wyoming, and Utah, in explorations for fossil insects, and in collecting recent Coleoptera and Orthoptera, especially in the higher regions. They made large collections of recent insects at different points along the railways from Pueblo to Cheyenne and from Cheyenne to Salt Lake, as well as at Lakin, Kans., Garland and Georgetown, Colo. and in various parts of the South Park and surrounding region.

For want of time, they were obliged to forego an anticipated trip to White river, to explore the beds of fossil insects known to exist there. Ten days were spent at Green river and vicinity in examining the Tertiary strata for fossil insects, with but poor results; the Tertiary beds of the South Park yielded but a single determinable insect, but near Florissant the Tertiary basin, described by Dr. A. C. Peale in the annual report of the Survey, for 1873, was found to be exceedingly rich in insects and plants.

In company with Rev. Mr. Lakes, of Golden, Mr. Scudder spent several days in a careful survey of this basin and estimates the insect-bearing shales to have an extent at least fifty times as great as those of the famous locality at Œningen in Southern Bavaria. From six to seven thousand insects and two or three thousand plants have already been received from Florissant, and as many more will be received before the close of the year.

Mr. Scudder was also able to make arrangements in person with parties who have found a new and very interesting locality of Tertiary strata in Wyoming, to send him all the specimens they work out, and he confidently anticipates receiving several thousand insects from them in the course of the coming winter. The specimens from this locality are remarkable for their beauty. There is, therefore, every reason to believe that the Tertiary strata of the Rocky mountain region are richer in remains of fossil insects than any other country in the world, and that within a few months the material at hand for the elaboration of the work on fossil insects, which Mr. Scudder has in preparation for the Survey, will be much larger than was ever before subject to the investigation of a single naturalist.

Prof. Joseph Leidy, the eminent comparative anatomist and microscopist, made his second visit to the West the past season, under the auspices of the Survey. He made a careful exploration of the country about Fort Bridger, Uintah mountains, and the Salt Lake basin, in search of rhizopods. He has been engaged for a long

time on a memoir on this subject, which will eventually form one of the series of the quarto reports of the Survey.

The botany of the Survey was represented the past season by the two great masters of that department, Sir Joseph D. Hooker, director of the Gardens of Kew, England, and president of the Royal Society of London; and Prof. Asa Gray, of Cambridge, Mass. Their examinations extended over a great portion of Colorado, Wyoming, Utah, Nevada, and California. Their investigations into the alpine floras and tree vegetation of the Rocky mountains and Sierra Nevada enabled them to give a clear idea of the relations and influence of the climatic conditions on both sides of the great mountain-ranges.

Sir Joseph Hooker, whose botanical researches embrace the greater part of Europe; the Indies from the bay of Bengal across the Himalayas to Thibet; the Antarctic regions and the southern part of South America, New Zealand, Australia, South Africa, Morocco and Asia Minor, presents in the English periodical "*Nature*," for October 25, an outline of his studies during the season, and this outline when filled out will form a most important report for the eleventh annual report of the Survey. It will be seen at a glance that the report will be of the most comprehensive character, and cannot fail to be of the highest interest to our people. The tree vegetation, and especially the coniferæ, were made special objects of study, and many obscure points were cleared up.

Of a section of the Rocky mountains comprising Colorado, Wyoming, and Utah, Dr. Hooker says:

Such a section of the Rocky mountains must hence contain representatives of three very distinct American floras, each characteristic of immense areas of the continent. There are two temperate and two cold or mountain floras, viz: (1) a prairie flora derived from the eastward; (2) a so-called desert and saline flora derived from the west; (3) a subalpine; and (4) an alpine flora; the two latter of widely different origin, and in one sense proper to the Rocky Mountain ranges.

The principal American regions with which the comparison will have first to be instituted are four. Two of these are in a broad sense humid; one, that of the Atlantic coast, and which extends thence west to the Mississippi river, including the forested shores of that river's western affluents; the other, that of the Pacific side, from the Sierra Nevada to the western ocean; and two inland, that of the northern part of the continent extending to the

Polar regions, and that of the southern part extending through New Mexico to the Cordillera of Mexico proper.

The first and second (Atlantic plus Mississippi and Pacific) regions are traversed by meridional chains of mountains approximately parallel to the Rocky mountains, namely, on the Atlantic side by the various systems often included under the general term Appalachian, which extend from Maine to Georgia, and on the Pacific side by the Sierra Nevada, which bound California on the east. The third and fourth of the regions present a continuation of the Rocky mountains of Colorado and Utah, flanked for a certain distance by an eastern prairie flora extending from the British Possessions to Texas, and a western desert or saline flora, extending from the Snake river to Arizona and Mexico. Thus the Colorado and Utah floras might be expected to contain representatives of all the various vegetations of North America, except the small tropical region of Florida, which is confined to the extreme south-east of the continent.

The most singular botanical feature of North America is unquestionably the marked contrast between its two humid floras, namely, those of the Atlantic plus Mississippi, and the Pacific one; this has been ably illustrated and discussed by Dr. Gray, in various communications to the American Academy of Sciences, and elsewhere, and he has further largely traced the peculiarities of each to their source, thus laying the foundation for all future researches into the botanical geography of North America; but the relations of the dry intermediate region either to these or to the floras of other countries had not been similarly treated, and this we hope that we have now materials for discussing.

Dr. Hooker sums up the results of the joint investigations of Dr. Gray and himself, aided by Dr. Gray's previously intimate knowledge of the elements of the American flora, from the Mississippi to the Pacific coast:

The vegetation of the middle latitudes of the continent resolves itself into three principal meridional floras, incomparably more diverse than those presented by any similar meridians in the Old World, being, in fact, as far as the trees, shrubs, and many genera of herbaceous plants are concerned, absolutely distinct. These are the two humid and the dry intermediate regions above indicated.

Each of these, again, is subdivisible into three, as follows:

1. The Atlantic slope plus Mississippi region, subdivisible into (α) an Atlantic (β), a Mississippi valley, and (γ) an interposed mountain region with a temperate and subalpine flora.

2. The Pacific slope, subdivisible into (α) a very humid, cool, forest-clad coast range; (β) the great, hot, drier Californian valley formed by the San Juan river flowing to the north and the Sacramento river flowing to the south, both into the bay of San Fran-

cisco; and (γ) the Sierra Nevada flora, temperate, subalpine and alpine.

3. The Rocky Mountain region (in its widest sense extending from the Mississippi beyond its forest region to the Sierra Nevada), subdivisible into (α) a prarie flora, (β) a desert or saline flora, (γ) a Rocky Mountain proper flora, temperate, subalpine, and alpine.

As above stated, the difference between the floras of the first and second of these regions is specifically, and to a great extent generically, absolute; not a pine or oak, maple, elm, plane or birch of Eastern America extends to Western, and genera of thirty to fifty species are confined to each. The Rocky Mountain region again, though abundantly distinct from both, has a few elements of the eastern region and still more of the western.

Many interesting facts connected with the origin and distribution of American plants, and the introduction of various types into the three regions, presented themselves to our observation or our minds during our wanderings. Many of these are suggestive of comparative study with the admirable results of Heer's and Lesquereux's investigations into the Pliocene and Miocene plants of the north temperate and frigid zones, and which had already engaged Dr. Gray's attention, as may be found in his various publications. No less interesting are the traces of the influence of a glacial and a warmer period in directing the course of migration of Arctic forms southward, and Mexican forms northward in the continent, and of the effects of the great body of water that occupied the whole saline region during (as it would appear) a glacial period.

Lastly, curious information was obtained respecting the ages of not only the big trees of California, but of equally aged pines and junipers, which are proofs of that duration of existing conditions of climate for which evidence has hitherto been sought rather among fossil than among living organisms.

Up to the year 1874 rumor had been telling many marvelous stories of strange and interesting habitations of a forgotten people, who once occupied the country about the headwaters of the Rio San Juan, but these narrations were so interwoven with romance that but few people placed much reliance upon them. To those well versed in archæology, ruins of an extensive and interesting character were known to exist throughout New Mexico and Arizona, and the various reports of Abert, Johnson, Sitgreaves, Simpson, Whipple, Newberry, and others form our most interesting chapter in ancient American history; but their researches, aside from the meager accounts published by Newberry, throw no light on the marvelous cliff dwellings and towns north of the San Juan. In 1874 the photographic division of the United States Geological

Survey was instructed, in connection with its regular work, to visit and report upon these ruins, and in pursuance of this object made a hasty tour of the region about the Mesa Verde and the Sierra el Late, in South-western Colorado, the results of which trip, as expressed by Bancroft, in the Native Races of the Pacific Coast, "although made known to the world only through a three or four days' exploration by a party of three men, are of the greatest importance." A report was made and published, with fourteen illustrations, in the Bulletin of the United States Geological and Geographical Survey of the Territories, second series, No. 1.

The following year the same region was visited by Mr. W. H. Holmes, one of the geologists of the survey, and a careful investigation made of all the ruins. Mr. Jackson, who had made the report the previous year, also revisited this locality, but extended his explorations down the San Juan to the mouth of the De Chelly, and thence to the Moqui villages in North-eastern Arizona. Returning, the country between the Sierra Abajo and La Sal and the La Plata was traversed, and an immense number of very interesting ruins were first brought to the attention of the outside world by the report which was published the following winter by Messrs. Holmes and Jackson, in the Survey, Vol. II., No. 1.

The occasion of the Centennial Exhibition at Philadelphia led to the idea of preparing models of these ruins for the clearer illustration of their peculiarities, four of which were completed in season for the opening of the Exhibition. Since that time not only the number of these interesting models has been increased, but they have been perfected in execution, and faithful delineations have thus been secured of these mysterious remains of an extinct race who once lived within the borders of our western domain.

A visit to the *atelier* of Mr. Jackson, photographer of the Survey, enables one to inspect, in miniature size, the dwellings of the Moqui, and in full size a large collection of the ceramics and implements of those ancient and extinct people of our continent. A study of the models will give a very excellent idea of the ruined dwellings themselves. The first of these models, executed by Mr. Holmes, with whom the idea originated, represents the cliff house of the Mancos Cañon, the exterior dimensions of which are 28 inches in breadth by 46 inches in height, and on a scale of 1.24, or two feet to the inch. This is a two-story building, constructed

of stone, occupying a narrow ledge in the vertical face of the bluff 700 feet above the valley, and 200 feet from the top. It is 24 feet in length and 14 feet in depth, and divided into four rooms on the ground-floor. The beams supporting the second floor are all destroyed. The doorways, serving also as windows, were quite small, only one small aperture in the outer wall facing the valley. The exposed walls were lightly plastered over with clay, and so closely resembled the general surface of the bluff that it becomes exceedingly difficult to distinguish them at a little distance from their surroundings.

The second model of this series was constructed by Mr. Jackson, and represents the large "cave town," in the valley of Rio de Chelly near its junction with the San Juan. This town is located upon a narrow bench, occurring about 80 feet above the base of a perpendicular bluff some 300 feet in height. It is 545 feet in length, about 40 feet at its greatest depth, and shows about 75 apartments on its ground-plan. The left-hand third of the town, as we face it, is overhung some distance by the bluff, protecting the buildings beneath much more perfectly than the others. This is the portion represented by the model. A three-story tower forms the central feature; upon either side are rows of lesser buildings, built one above another upon the sloping floor of rock. Nearly all these buildings are in a fair state of preservation. This model is 37 by 47 inches, outside measurements, and the scale 1.72, or 6 feet to the inch. A "restoration" of the above forms the third in the series, of the same size and scale, and is intended as its name implies, to represent as nearly as possible the original condition of the ruin. In this we see that the approaches were made by ladders and steps hewn in the rock, and that the roofs of one tier of rooms served as a terrace for those back of them, showing a similarity, at least, in their construction to the works of the Pueblos in New Mexico and Arizona. Scattered about over the buildings are miniature representations of the people at their various occupations, with pottery and other domestic utensils.

The "triple-walled tower," at the head of the McElmo, is the subject of the fourth model. It was constructed by Mr. Holmes, and represents, as indicated by its title, a triple-walled tower, situated in the midst of a considerable extent of lesser ruins, probably of dwellings, occupying a low bench bordering the dry wash of the McElmo. The tower is 42 feet in diameter, the wall two feet

thick, and now standing some 12 feet high. The two outer walls inclose a space of about 6 feet in width, which is divided into 14 equally-sized rooms, communicating with one another by small window-like doorways. The next is a "cliff-house" in the valley of the Rio de Chelly. It is about 20 miles above the cave town already spoken of. This is a two-story house, about 20 feet square, occupying a ledge some 75 feet above the valley, and overhung by the bluff. The approach from the valley is by a series of steps hewn in the steep face of the rock; and this method was the one most used by the occupants, although there is a way out to the top of the bluff. This model is 42 inches in height by 24 broad, and is built upon a scale of 1.36.

Téwa, one of the seven Moqui towns in North-eastern Arizona, is a very interesting and instructive model, representing, as it does, one of the most ancient and best authenticated of the dwellings of a people who are supposed to be the descendants of the cliff-dwellers. Téwa is the first of the seven villages forming the province as we approach them from the east, and occupies the summit of a narrow mesa some 600 feet in height and 1,200 yards in length, upon which are also two other somewhat similar villages. The approach is by a circuitous road-way hewn in the perpendicular face of the bluff which surrounds the mesa upon all sides. It is the only approach accessible for animals to the three villages. Other ladder-like stairways are cut in the rock, which are used principally by the water-carriers, for all their springs and reservoirs are at the bottom of the mesa. This village is represented upon a scale of 1 inch to 8 feet, or 1.96. The dimensions of the model are 36 inches in length, 29 inches in width and 14 inches in height.

In the spring of 1877 Mr. Jackson made a tour over much of the northern part of New Mexico, and westward to the Moqui towns in Arizona, and secured materials for a number of very interesting models, illustrating the methods of the Pueblos or town-builders in the construction of their dwellings. Two villages have been selected for immediate construction, as showing the most ancient and best known examples of their peculiar architecture, viz: Taos and Acoma; the one of many-storied, terraced houses, and the other built high up on an impregnable rock. The model of Taos is now completed, the dimensions of which are 42 by 39 inches, and the scale one inch to twenty feet, 1:240.

Of this town Davis says:

It is the best sample of the ancient mode of building. Here are two large houses three or four hundred feet in length, and about one hundred and fifty feet wide at the base. They are situated upon opposite sides of a small creek, and in ancient times are said to have been connected with a bridge. They are five and six stories high, each story receding from the one below it, and thus forming a structure terraced from top to bottom. Each story is divided into numerous little compartments, the outer tier of rooms being lighted by small windows in the sides, while those in the interior of the building are dark, and are principally used as store-rooms. * * * The only means of entrance is through a trap-door in the roof, and you ascend from story to story by means of ladders on the outside, which are drawn up at night.

Their contact with Europeans has modified somewhat their ancient style of buildings, principally in substituting doorways in the walls of their houses for those in the roof. Their modern buildings are rarely over two stories in height, and are not distinguishable from those of their Mexican neighbors. The village is surrounded by an adobe wall, which is first included within the limits of the model, and incloses an area of eleven or twelve acres in extent. Within this limit are four of their *estufas* or secret council-houses. These are circular under-ground apartments, with a narrow opening in the roof, surrounded by a palisade, ladders being used to go in and out.

These models are first carefully built up in clay, in which material all the detail is readily secured, and are then cast in plaster, a mold being secured by which they are readily multiplied to any extent. They are then put in the hands of the artists and carefully colored in solid oil paints to accurately resemble their appearance in nature, and in case of restorations or modern buildings, all the little additions are made which will give them the appearance of occupation. The Survey is in possession of the data for the construction of many more models, and they will be brought out as opportunity is given. They have also, in connection with the views, multiplied many of the curious pieces of pottery which have been brought back from that region by the various parties connected with the survey.

RECENT LITERATURE.

DARWIN'S DIFFERENT FORMS OF FLOWERS ON PLANTS OF THE SAME SPECIES[1].—All botanists may not become Darwins, but if a perusal of this and the other works of their talented author, should induce any of the present collectors of local floras, and describers of dried plants, to at least devote a moiety of their leisure to observing flowers, their daily conduct of life, how they grow and reproduce their kind, their relation to one another, to insects and to the world at large; observations, however, in many cases requiring care and patience, as well as some genius, then would in time be reared a crop of botanists, who would bridge the chasm now yawning between the ordinary herbalist—no farther advanced now, perhaps, than in the days of Gerarde—and the author of this book and its predecessors. This work, however, interesting as it is, was not written for the public, but for the few who have, since 1862, read the Journal of the Linnean Society, which contains the papers forming the body of this book, which are here republished in a connected and corrected form, together with some new matter, and is now in such an attractive form that few who have read Mr. Darwin's former writings will neglect the present work.

Premising that, in the words of the author, cleistogamic flowers are fertile, minute, completely closed, with the petals rudimentary, often with some of the anthers abortive, and the remaining ones together with the stigmas much reduced in size; that these flowers grow on the same plant with perfect and fully expanded flowers—we will now let the author give the results of his studies:

"I will now sum up very briefly the chief conclusions which seem to follow from the observations given in this volume. Cleistogamic flowers afford, as just stated, an abundant supply of seeds with little expenditure; and we can hardly doubt that they have had their structure modified and degraded for this special purpose; perfect flowers being still almost always produced so as to allow of occasional cross-fertilization. Hermaphrodite plants have often been rendered monœcious, diœcious, or polygamous; but as the separation of the sexes would have been injurious, had not pollen been already transported habitually by insects or by the wind from flower to flower, we may assume that the process of separation did not commence and was not completed for the sake of the advantages to be gained from cross-fertilization. The sole motive for the separation of the sexes which occurs to me, is that the production of a great number of seeds might become superfluous to a plant under changed conditions of life; and it might then be highly beneficial to it that the same flower or the same individual should not have its vital powers taxed, under the struggle for life

[1] *The Different Forms of Flowers on Plants of the same Species.* By CHARLES DARWIN, M. A., F. R. S., with illustrations. New York, D. Appleton & Co., 1877, 12mo., pp. 352.

to which all organisms are subjected, by producing both pollen and seeds. With respect to the plants belonging to the gyno-diœcious sub-class, or those which co-exist as hermaphrodites and females, it has been proved that they yield a much larger supply of seed than they would have done if they had all remained hermaphrodites; and we may feel sure from the large number of seeds produced by many plants that such production is often necessary or advantageous. It is therefore probable that the two forms in this sub-class have been separated or developed for this special end.

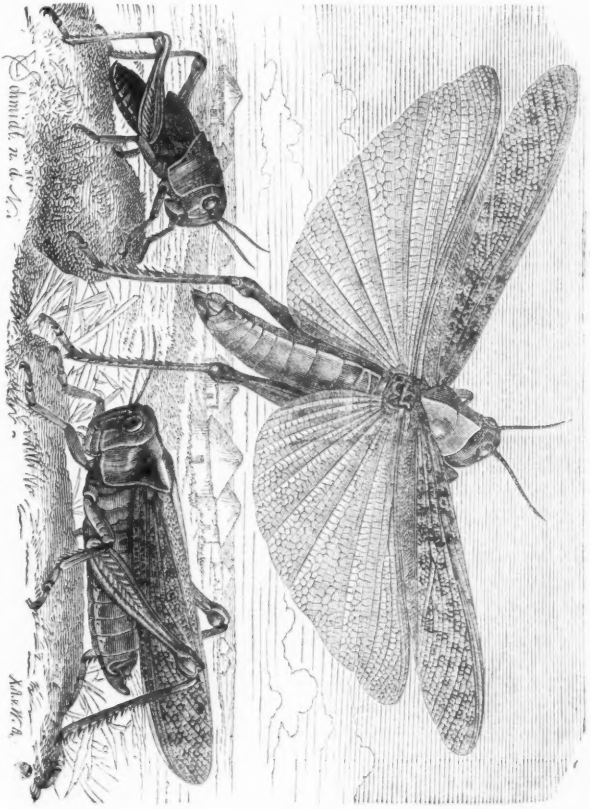
Various hermaphrodite plants have become heterostyled, and now exist under two or three forms; and we may confidently believe that this has been effected in order that cross-fertilization should be assured. For the full and legitimate fertilization of these plants pollen from the one form must be applied to the stigma of another. If the sexual elements belonging to the same form are united the union is an illegitimate one and more or less sterile. With dimorphic species two illegitimate unions, and with trimorphic species twelve are possible. There is reason to believe that the sterility of these unions has not been specially acquired, but follows as an incidental result from the sexual elements of the two or three forms having been adapted to act on one another in a particular manner, so that any other kind of union is inefficient, like that between distinct species. Another and still more remarkable incidental result is that the seedlings from an illegitimate union are often dwarfed and more or less or completely barren, like hybrids from the union of two widely distinct species."

BREHM'S ANIMAL LIFE.[1]—We have already (Vol. xi. p. 557) in general terms called attention to the elaborate and useful work of which the present volume forms a part. Prof. Taschenberg, the author of this volume, is well known for his studies on the lower Hymenoptera and his work on economic entomology. He brings to the task ripe scholarship, a pleasant style, and is aided by an artist whose success greatly enhances the value of the work. In a few introductory pages, Prof. Taschenberg treats of the anatomy, physiology, and transformations of insects, and then enters at once upon a very general description of the more interesting forms of the families of insects, beginning with the beetles and ending with the myriopods, spiders and mites. The *Linguatulidæ*, and *Pantopoda* (Pycnogonidæ) are included, and the Tardigrades are briefly noticed.

The work is well worth the cost to one even who cannot read German with facility, from the graphic, full-page illustrations, and the cuts which abound in the text. The picture of the dead and probably stinking mole hanging by its snare, and overrun with a

[1] *Brehm's Thierleben.* Band 9. Die Insekten, Tausenfüssler und Spinner. Von DR. E. L. TASCHENBERG. Mit 227 Abbildungen im Text und 21 Tafeln, von Emil Schmidt. Leipzig, 1877. New York, B. Westerman & Co. New York. 8vo. pp. 711, xx. $5.00.

host of scavenger beetles and flies, will give the beginner in entomology a graphic idea of the value of such a "find" to these insects; as will also the plate designed to face p. 62, of a dead bird with similar accompaniments. The plate entitled "a spring-



THE LOCUST OF THE OLD WORLD, NATURAL SIZE.

picture" and "insect-life" is well drawn, as is that of the ant's nest in the forest, and the "reign of flies," the "night-search for insects," and the bird-killing spider (*Mygale avicularia*). The cuts in the text are drawn by Herr Schmidt with fidelity and grace, very few stiff figures appearing.

We think more might have been said and pictured about the habits of bees and wasps, and some drawings of their nests, particularly those of the tropics, introduced. The accompanying cut of the locust of the Old World will give the reader some idea of the nature of the illustrations in the text, and give our western read-

ers a notion of the size and power of the creature by which in the eastern hemisphere the prophet Joel, who left us the first entomological monograph ever written, was so impressed.

NATURAL HISTORY AND GEOLOGY IN BOHEMIA.—We have received for notice several important works, containing many lithographic illustrations, upon the botany, natural history, palæontology and geology of Bohemia, by several scientists of Prague, entitled, Archiv für die Naturwissenschaftliche Landesdurchforschung von Böhmeń, edited by Profs. Koristka and Krejei, who contribute several topographical and geological memoirs to the first volume, which appeared in 1869. Dr. Fric writes on the fossils of the chalk formation, and C. Feistmantel discusses the geology of the coal basin of Bohemia, while Dr. Celakovsky contributes a lengthy prodromus of the flora of Bohemia; Herr Lokaj catalogues the beetles; Alfred Slavik, the land and freshwater molluscs, and E. Barta, the spiders. In the second volume, published in 1873, the prodromus of the flora is continued; and Dr. Fric enumerates the vertebrates and crustacea, and describes the river fisheries of Bohemia. The third part of the prodromus of the flora appeared in 1875, and in 1876 was published Rosicky's Myriopoda of Bohemia.

THE works of the Geological Division, as far as received by us, comprise Dr. Em. Boricky's petrographical studies on the basalts, phonolitic and melaphyr rocks of Bohemia, with six fine colored chromo-lithographic, and two plain plates (1874–1876). The second volume contains Dr. A. Fric's fauna of the coal formation of Bohemia, wherein he describes and figures a fossil scorpion (*Cyclopthalmus senior* Corda.), a new spider (*Palaranea borassifolia*), and a remarkable Tetradecapod crustacean (*Gampsonychus parallellus* Fric), with broad caudal appendages, and apparently forming a synthetic type, combining Decapod with Amphipod features, and bearing perhaps a family resemblance to our Illinois Carboniferous crustacean, *Acanthotelson* of Meek and Worthen; it has sessile eyes. Karl Feistmantel's Coal basins in different localities of Bohemia; Vala and Helmhacker's iron ores in the region of Prague and Beraun, and Helmhacker's geological description of portions of Bohemia, with a valuable work by Dr. G. C. Laube on the geology of the Erz mountains of Bohemia, are all valuable and fully illustrated; but undoubtedly Boricky's important work on microscopical petrography will excite a very considerable degree of interest among American geologists. The works can be obtained of Fr. Rivnac, the publisher, at Prague, Austria.

KIRBY'S SYNONYMIC CATALOGUE OF BUTTERFLIES.[1]—The appearance of the supplement to this work warrants some notice of one

[1] *A Synonymic Catalogue of Diurnal Lepidoptera.* By W. F. KIRBY. London, 1871. Supplement, March 1871—June, 1877. London, 1877, 8vo. pp. 883. Van Voorst.

of the most useful books of reference the entomologist can have upon his book-shelves. The original work forms a bulky octavo of 690 pages, while the supplement, even, is paged from 691 to 883. As this contains simply a synonymic list of one group of Lepidoptera, one may form some idea of its extent, and the labor involved in its preparation.

FERNS OF NORTH AMERICA.[1]—The first part, now before us, more than meets the expectations formed when the work was announced. Professor Eaton has treated the subject in a clear and methodical way; presenting in a popular form detailed descriptions characterized by the great merits of readability and accuracy. The plates are well done both by artist and lithographers. In the first part the following species are figured and described: *Lygodium palmatum, Cheilanthes vestita* and *cooperæ, Asplenium serratum.* There is also a synopsis of the species of Cheilanthes known to occur in the United States. This work of so much promise can be most heartily recommended to botanical teachers and students. The low price at which it is offered is a pleasant surprise to many who are familiar with the cost of such productions, and it is to be earnestly hoped that the projectors of this enterprise may receive from the public the support to which it is entitled.—*G. L. G.*

FLOWER'S OSTEOLOGY OF THE MAMMALIA.[2]—This valuable résumé of the osteology of the Mammalia, may be recommended to those desiring a knowledge of the subject, as the best manual in our language. While not exhaustive, it is full of information, especially in regard to cranial characters, and the text is elucidated by numerous and good wood-cuts. A number of allusions to the development of the several parts of the skeleton are scattered through the volume, and the systematic views of the writer are generally expressions of the latest results obtained in the field covered by the work. It furnishes an excellent introduction to the study of the palæontology of the *Mammalia.* Messrs. Macmillan have long since earned the thanks of biologists by their zeal in publishing works of this class, preferring in some instances at least the position of public instructors to the accumulation of large profits on outlays.

THE MORPHOLOGY OF THE SKULL,—by W. K. Parker and G. T. Bettany.[3] This is another of the excellent manuals published by the Messrs. Macmillan. It consists of a general abstract of the papers by Prof. W. K. Parker, chiefly published in The Philo-

[1] *Ferns of North America.* By Prof. DANIEL C. EATON, of Yale College. Published by S. E. Cassino, Naturalist's Agency, Salem, Mass. Part I, price $1.

[2] *An Introduction to the Osteology of the Mammalia.* By WM. HENRY FLOWER, F. R. S., F. R. C. S. London, Macmillan & Co., 12mo. pp. 349 Second Edition.

[3] *The Morphology of the Skull.* By Prof. W. K. PARKER, F. R. S., and F. BETTANY, M. A. London, Macmillan & Co., 1877. 12mo. pp. 368.

sophical Transactions of the Royal Society, on the development of the skull in various vertebrate animals. These are the skate and dogfish, the salmon, axolotl, frog, snake, fowl and pig. Appendices on the general structure of the skull of the orders to which these animals belong, together with one on the human skull, are added. A preliminary chapter on general embryology, and a closing one on the general homologies of the elements of the cartilaginous and osseous skulls, complete the work. The mode of treatment of the subject by Prof. Parker is lucid, and the text is illustrated by numerous excellent cuts. It is the best manual of the subject in the English language, and to the student of any aspect of the osteology of vertebrata, is invaluable. It introduces an extensive and difficult department to a large class who do not read German or French with sufficient facility to master the subject in those languages. We observe with pleasure that the authors are not contented with the dry enumeration of facts alone, but are willing to indulge in reflections on the wider bearings of their theme. Their observations on the homologies of the cranial elements, and the nature of the supposed segments, are interesting and judicious, and we refer to them (pp. 331, 342–3, 359) as models of cautious induction without affectation of an ignorance, which is greater than their knowledge of the facts demand.

RECENT BOOKS AND PAMPHLETS.—A Text Book of Physiology. By M. Foster, M.A., M.D., F.R.S. London: Macmillan & Co., 1877. 8vo, pp. 889. $6.00.

United States Geological Exploration of the Fortieth Parallel. Clarence King, Geologist-in-Charge. Microscopical Petrography. By Ferdinand Zirkel. Illustrated by twelve plates. Washington, 1876. 4to, pp. 297.

Sixth Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. The first biennial Report. By Cyrus Thomas, Ph.D. Springfield, Ill., 1877. 8vo, pp. 180.

Brehm's Thierleben. Band ii, Heft 8–11 iii. 1–8. Leipzig, 1877. New York: B. Westermann & Co. 8vo. 40 cents a Heft.

Zur Kenntniss des Einflusses der äusseren Lebensbedingungen auf die Organisation der Thiere. Von Wladimir Schmankewitsch (Zeitschrift für wiss. Zoologie. Band xxix). 8vo, pp. 65.

Life Histories of the Birds of Eastern Pennsylvania. By Thomas G. Gentry. Vol. ii. Salem, Mass., Naturalist's Agency. 1877. 12mo, pp. 336.

On New Forms of Actiniaria dredged in the Deep Sea; with a Description of certain Pelagic Surface-swimming Species. By H. N. Moseley. 4to, pp. 10, with a plate.

On two Forms of Deep-sea Ascidians; obtained during the voyage of H. M. S. *Challenger*. By H. N. Moseley. 4to, pp. 8. (From the Linnæan Transactions, Ser. 2d, vol. i.)

On the Structure of a species of Millepora occurring at Tahiti, Society Islands. By H. N. Moseley. (From the Philosophical Transactions of the Royal Society, vol. 167, part 1.) 4to, pp. 18.

On the larval Characters and Habits of the Blister-beetles, belonging to the genera Macrobasis Lec. and Epicauta Fabr.; with Remarks on other species of the family Meloidæ. On a remarkable new genus in Meloidæ infesting Mason-bee Cells in the United States. Additional Notes on Megathymus yuccæ. Further Remarks on Pronuba yuccasella, and on the Pollination of Yucca. On the Differences between Anisopteryx pometaria How., and Anisopteryx æscularia W.-V., with Remarks on the genus Paleacrita. By C. V. Riley. (From the Transactions of the Academy of Science of St. Louis. Vol. iii, No. 4.) 1877. 8vo, pp. 34.

Polar Colonization. The Preliminary Arctic Expedition of 1877. Washington, D. C. 8vo, pp. 32.

Immortality. All Life conditionally Immortal. By William Bross. Chicago: Jansen, McClurg & Co. 8vo, pp. 8.

The Geological Formations of La Salle county, and their Organic Remains. By William W. Calkins. 12mo, pp. 11.

Recent Investigations of Embryologists. By Charles Sedgwick Minot. (From the Proceedings of the Boston Society of Natural History, xix.) 8vo, pp. 7.

Report on the present state of our knowledge of the Crustacea. Part i, ii. On the Homologies of the Dermal Skeleton. By C. Spence Bate. (From the Report of the British Association for the Advancement of Science for 1875, 1876.) 8vo, pp. 12, 20.

Geology of Wisconsin, Surveys of 1873–1877; Vol, II. Part I, Historical; II, Eastern Wisconsin; III, Central Wisconsin; IV, Lead Region. Accompanied by an atlas of maps. Published under the direction of the Chief Geologist, T. C. Chamberlin, by the State Commissioners of Public Printing, Madison, Wis. 1877. 8vo, pp. 768.

Palæontological Bulletin, No. 28. On new Vertebrata from the Upper Tertiaries of the West. On new Saurians discovered by Mr. Wheatley in the Trias of Pennsylvania. On the Vertebrata of the Dakota Epoch of Colorado. By E. D. Cope. (Read before the American Philosophical Society, December 21, 1877.) 8vo, pp. 28.

Bulletin of the Buffalo Society of Natural Sciences; Vol III. Buffalo. From April, 1875, to August, 1877. 8vo, pp. 230.

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GENERAL NOTES.

BOTANY.

LAVALÉE'S ARBORETUM SEGREZIANUM.[1]—This is a handsome volume of some 500 pages, containing a catalogue of the trees and shrubs collected by Mons. Lavalée on his estate at Segrez, a few miles south of Paris, with their synonyms, origin, and with abundant references to the most accessible figures. In an interesting preface M. Lavalée tells us how, from a small beginning ten years ago, his collection has grown until it contains more than 3000 species and garden varieties; of the excessive labor which its formation and scientific arrangement has enjoined on him; and of the many difficulties he encountered in determining the names of the plants which he has ransacked Europe to procure. How admirably he has overcome these difficulties, difficulties which will hardly be appreciated except by those who have undertaken the formation of a large scientific collection of living plants, his pages tell.

The second portion of the preface is devoted to a by far too short historical sketch of the principal collections of exotic trees, which have been found in France from the time of René du Bellay, in the middle of the sixteenth century, down to that which Vilmorin brought together on his estate at Barres; now fortunately in possession of the State as a school of forestry.

[1] *Arboretum Segrezianum—Enumeration des Arbres et Arbrisseaux Cultivés à Segrez.* Par ALPH. LAVALÉE. (Paris: J. B. Baillière et Fils. 1877.)

In the body of the catalogue a few errors are noticeable, mistakes in the spelling of foreign name are not infrequent, and the synonomy and origin of some plants (*Rubus didicenisus* is given as a native of Canada) will require correction for another edition, from which no doubt further study will remove some of the doubtful species credited to North America. To directors of botanic gardens, or to those whose duty it is to care for such collections, the *Arboretum Segrezianum* will be an invaluable aid. A volume of plates with technical descriptions of some of the last and little known species in M. Lavalée's Arboretum is promised, and is, we believe, already in press.—*C. S. Sargent.*

Researches in regard to Transpiration in Plants.—J. Wiesner has published, in Annales des Sciences Naturelles, an account of his experiments upon this subject. The following is a statement of his conclusions:

The effect of light upon transpiration is most obvious in the case of plants of a green color. The comparison of green and etiolated maize does not leave any room for doubt.

The functions of chlorophyll in transpiration are evident. A part of the light which traverses the chlorophyll is transformed into heat, and from this results an elevation of temperature in the tissues. Increase of tension of aqueous vapor in the intercellular space follows, and the excess of vapor passes out by the stomata.

It is therefore easy to understand how a plant can transpire in a saturated atmosphere, but only under influence of light.

These experiments were conducted in three ways: by comparing green and etiolated plants, by exposing the plant to the solar spectrum, and by placing them behind solutions of chlorophyll.

The results from these three methods agree. They show that the presence of chlorophyll appreciably augments the action of light on transpiration; that it is the rays corresponding to the absorption bands of the chlorophyll spectrum, and not the more luminous rays which excite transpiration; and finally that the rays which have passed through a solution of chlorophyll exert only a feeble influence on transpiration.

Other coloring matters, like xanthophyll for example, act like chorophyll, but to a less degree. Wiesner does not deny that opening of the stomata may accelerate transpiration in sunlight, but the very great transpiration of maize, the stomata of which were closed, and the feeble transpiration of *Hartwegia comosa*, in which they were largely open in the dark, suffice to indicate that they are not the principal cause of transpiration in the light.

The dark heat rays act in a very appreciable manner, but less than the luminous rays. So far as the ultra-violet chemical rays are concerned their action is *nil* or exceedingly slight.

Whatever the nature of the rays, they always act by increasing the temperature of the tissues.

Wiesner concludes his paper by the statement: "The physiological end of the absorption of light is no longer a secret, and I have at the same time detected a new function of chlorophyll."—*Annales des Sciences Naturelles, September.*

To the above may be added a brief reference to a note by Déherain, in which he states that he had obtained results different from those of Wiesner, and that he is soon to criticise further Wiesner's paper.

Botanical News.—*Trimen's Journal of Botany* for December, besides articles of local interest, contains an interesting discussion of some questions of botanical nomenclature, by J. Ball; some contributions to plant-chemistry, by A. H. Church; notes on Japanese and Bermudian ferns, and notes on some hybrid brambles, by W. O. Focke; Julius Wiesner's work on the influence of light and radiant heat on the transpiration in plants is abstracted. The journal contains a discriminating review of Darwin's Different Forms of Flowers on Plants of the same Species.

The Bulletin of the Torrey Botanical Club for November and December, contains Wolle's enumeration of Fresh Water Algæ, which embraces upwards of 150 forms new to the United States, and 24 species new to science. Mr. Meehan describes the habits of *Gentiana andrewsii*. Mr. C. F. Austin describes *Danthonia faxoni* n. sp., and two new mosses, while Mr. Davenport presents a description of a new fern, *Cheilanthes viscida*, from California.

ZOÖLOGY.[1]

Peculiar Feathers of the young Ruddy Duck.—The unusually narrow, rigid and acuminate tail-feathers which constitute a character of the genus *Erismatura* are much more peculiar at an early stage of their growth. The curious structure will doubtless be new to most readers of the Naturalist.

The accompanying cut will give an idea of the general appearance of the feather, which is, in fact, double, one complete feather growing on the end of another, and the two being dissimilar in structure.

To the naked eye the terminal feather appears to be simply a prolongation of the shaft of the other, as a slightly swollen, stiff stem projecting an inch or more beyond the true web, and bearing upon its terminal half a bunch of loose, disconnected barbs, more or less recurved, and fringed with light fluffy barbules. With a lens this terminal portion is seen to be a distinct feather, complete in all its parts, borne upon the end of the other. It has a simple

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

cylindrical barrel for half its length; at the point where the vane begins, it sends off a bunch of barbs constituting an after-shaft; it then becomes channeled along the under side, and gives off its loose barbs alternately on either side, forming a disconnected vane; thus presenting all the more essential parts of a complete feather (whether barbicels and hooklets are present or not I cannot now determine for want of a microscope). The proximal half of this duplex affair is in all respects a perfect feather of ordinary character. The distinction of the two feathers is clearly seen at the point where the end of the channeled and densely-pithy shaft changes into the enlarged, cylindrical and nearly hollow quill of the terminal supplementary feather. The relations of the two being such, they must have sprouted from the same matrix, one after the other, the true feather following after the temporary downy one, which is deciduous, and falls off when the duckling is about ten inches long. The process is essentially the same, of course, as that by which the downy tip of an ordinary contour-feather is shed; but it might not be expected to occur in the case of such a particularly strong and stiff rectrix as Erismatura possesses.—*Elliott Coues, Turtle Mountain, Dakota, July*, 1874.

Note on Ranella clathrata Gray.—Last winter I collected the above species at Cedar Keys, Fla. I found the shells in shallow water, occupying *dead* shells of *Mercenaria mortoni*; also attached to the pretty little coral, *Oculina diffusa*. Through Mr. Bland I submitted specimens to Geo. W. Tryon, Jr., who, after a careful examination, identifies them as above. This is a west coast form not heretofore known to exist on the eastern coast, and adds another species to the list common to both oceans. *Ranella caudata* is our usual form, and abundant in Florida.—*W. W. Calkins.*

Sparrows and Peewees.—My residence is in the country (Chickies, Lancaster, Co., Pa.), and for about forty years the peewee flycatcher (*Sayornis fuscus*) has nested under my portico, until 1877, when several European or domestic sparrows (*Fringilla domestica*) appeared, and not only attacked the resisting peewees during several days when these were repairing their nest, but as fast as one party built the other demolished, tearing the nest to pieces and littering the porch below, without renewing or occupying the premises.—*S. S. Haldeman.*

The Prairie Chicken in California.—A fact of considerable interest to our sportsmen has recently been noted in connection with the prairie chicken. The absence of this choice bird of the prairies among the feathered game of California has been felt, and efforts have been made by individual enterprise to introduce and acclimate it. They have not been successful, and the possibility of this desirable result has remained in doubt. But it seems that the bird is solving the problem for us. Starting from the prairies

of Nebraska, it has followed the overland railroad westward, its appearance being noted from time to time in localities along the line where it had never before been seen. Gradually it followed westward until it reached Battle mountain and Winnemucca, on the line of the Central Pacific in Nevada. From these points it extended its wanderings northward into Surprise Valley, in north-eastern California, and is gradually spreading through the valleys extending down from Mount Shasta. Its diffusion over the whole State is now believed to be only a question of time and reasonable forbearance on the part of gunners.—*Salinas* (*California*) *Index.—Communicated by R. E. C. Stearns.*

On the Form of the Stapes in Dipodomys.—Upon making an examination of the bony ear of this animal recently, from specimens sent me through the courtesy of Professors Baird and Coues, from the National Museum, I was struck with the peculiarity in shape of the stapes, which did not present the usual flat base fitting into the fenestra ovalis. The part in question was very thin, inflated, hollow internally, with a salient rim jutting inwards, and a similar salient horizontal border or rim bounding it externally; from this flat rim the grooved crura arose, and united distally; an osseous tube giving passage to a vessel and nerve traverses the crural opening, as in many other Rodents and Insectivora. Looking at the base of the stapedial bone from the side above and little oblique it reminds one strongly of a minute hat with a rounded crown and narrow rim, while a view from the side calls to mind the shape of the carapace of an *Emys*. On making comparisons of my sketches with the remarkable collection of preparations of the internal ears of various vertebrates made by Professor Hyrtl, and now in the museum of the Philadelphia College of Physicians, to which I was very kindly permitted access through the courtesy of Dr. Bache, I found that the base of the stapes was similarly inflated with the convex surface dipping into the fenestrum, in *Hyrax*, *Mephitis*, *Erithizon*, and *Phalangista.—John A. Ryder.*

ANTHROPOLOGY.

Pliocene Man.—Prof. Cope has recently made an important addition to our knowledge of this subject in North America. He has received from Oregon a collection of fossils from an ancient lake-bed of Pliocene age which include the following species of mammalia: *Elephas primigenius*, *Equus occidentalis; E. major; Auchenia hesterna; A. major* Ow.; *A. vitakeriana* sp. nov.; *Mylodon* vel genus affine; *Lutra piscinaria*. Of birds: bones not distinguishable from those of *Podiceps occidentalis* and *Podibymbus podiceps;* others of *Graculus* similar in size to those of *Graculus penicillatus*. Fishes: *Catostomidæ* and *Cyprinidæ* of extinct species of *Alburnops* and *Anchybopsis*. Mingled in the same deposit in undistinguishable relation, were found

numerous flakes with arrow and spear heads of obsidian, many of them much tarnished by long erosion. All were lying mingled together on the surface of a bed of clay, which was covered by a deposit of "volcanic sand and ashes" of from fifteen to twenty feet in depth. This had been drifted away by the wind in some localities, thus exposing the remains. Great numbers of specimens of the fresh-water shell, *Carinifex newberryi*, of a white color, were found with the vertebrate fossils. The locality is the basin of a lake, a small remnant of which still remains, and is visited by numbers of *Mammalia* and water-birds at the present time.

POWELL'S NORTH AMERICAN ETHNOLOGY.—The first volume of a series of "Contributions to North American Ethnology" has recently been published at Washington, by Maj. J. W. Powell. It is a quarto volume of 361 pages, and contains a number of able papers, of which the following is a summary: Part I contains a paper "On the Distribution and Nomenclature of the Native Tribes of Alaska and adjacent territory," accompanied by an ethnographic map. The article consists of a brief review of the various tribes, their location and population; contributed by Mr. W. H. Dall. The same author is represented by a second paper, "On the succession of the Shell-heaps of the Aleutian Islands." This is a valuable contribution to our knowledge of the American *kjækkenmœddings*. The illustrations of the objects of art discovered among the different strata which mark the Littoral, the Fishing and the Hunting periods are numerous, and are described at length. Another article, by the same writer, "On the Origin of the Innuit" or Eskimo, concludes Part I. After reviewing the principal hypothesis of origin and migration, he assumes that the larger part of North America may have been peopled by way of Behring Straits. The appendix to Part I contains philological papers by Messrs. Furnhelm, Dall and Gibbs.

Part II consists of an interesting paper by Dr. Geo. Gibbs, concerning the habits and customs of the "Tribes of western Washington and north-western Oregon," with map showing the distribution of Indian tribes of Washington Territory, and a linguistic appendix, principally by Dr. Gibbs.—*E. A. Barber.*

ERRATUM.—Attention having been called, by Mr. E. Wilkinson, Jr., of Mansfield, Ohio, to a typographical error which occurred in one of my recent articles entitled "The Ancient and Modern Pueblo Tribes;" it may be well here to make the correction. On page 596 of Vol. XI of the NATURALIST, ancient *metates* or *tortilla* stones were described as measuring "a foot or fifteen *feet* square." It is scarcely necessary to state that *fifteen inches* was intended. Mr. W. further writes, "I have met with them (grinding stones) quite frequently, in fact every Mexican kitchen has one, and there seems to be an invariable size, viz: about 15 inches wide and 18 or 20 inches long."—*E. A. Barber.*

ANTHROPOLOGICAL NEWS.—Major Powell and Mr. F. W. Putnam, after the meeting of the American Association at Nashville, made some very important investigations among the mounds and slab-graves of Tennessee, of which Mr. Putnam will give an account in the next report of the Peabody Museum.

The Rev. Stephen Bowers has sent to the National Museum an exceedingly valuable collection of relics from the southern coast of California. The bone and shell implements and ornaments form the most attractive feature of the collection.

In the last volume of the Proceedings of the American Antiquarian Society, Mr. Stephen Salisbury, Jr., reproduces a romantic description of Dr. Le Plongeon's excavations in Yucatan, and his discovery of a statue called Chac-mool, with photo-lithographic drawings.

Some valuable information upon Mexican antiquities will be found in "Anales del Museo Nacional de Mexico, Tomo I., Entrega I^{a}, published in Mexico.

Mr. George J. Gibbs, of Turks and Caicos Islands, sends to the Smithsonian Institution a manuscript in which he endeavors to prove that those islands, and not Guanihani or Watlings Island, were the first landing place of Columbus. Enclosed in the manuscript was a photograph of another wooden stool, somewhat similar to that figured in the Smithsonian Report of 1876.

Jansen, McClurg & Co. have published in a separate pamphlet Gov. Bross's paper on immortality, or all life conditionally immortal, read before the American Association in Nashville.

The Munich Society of Anthropology have commenced the publication of a separate organ entitled "Beiträge zur Anthropologie und Urgeschichte Bayerns." The four parts already published are full of interesting matter and elegantly illustrated.

The following works of interest to anthropologists are announced: The Origin of Nations, Geo. Rawlinson (Scribner's); The Myths and Marvels of Astronomy, R. A. Proctor (Putnam); Mycenæ, Schlieman (Scribner's); Die Bevölkerung der Erde, Behm und Wagner (Supplement to Peterman's Mittheilungen); Works relating to the Eastern Question and to the Survey of India, Trübner's Catalogue; Cyprus, di Cesnola (Murray, London); The Cities and Cemeteries of Etruria, Geo. Dennis (ib.); China, a History of the Laws, Manners and Customs of the People, Ven. J. H. Gray (Macmillan).

In Professor Shield's recent work on the Final Philosophy are some very important sections upon anthropology.

On the shores of Mobile river, just above the city of Mobile, vast deposits of shells have been discovered. The Mobile and Ohio Railroad recently utilized one of these beds to pave their stock-yard, and in doing so unearthed some beautiful pottery and other relics of aboriginal settlement. Through the activity of Mr. K. M. Cunningham this treasure has been secured for the National Museum.

The following papers on American anthropology have appeared: Recent Discoveries in the American Bottom, by Mr. Henry R. Howland, Bull. Buffalo Soc. Nat. Sc., Mar. 2; The Mound-builders of Illinois, *Western Rev.*, Nov.; in the same periodical, the paper of H. A. Rush on Mound-builders in Missouri, before the American Association; Are the Indians dying out? S. N. Clarke, Bureau of Education; Col. Garrick Mallery read a paper before the Washington Philosophical Society, Dec. 8, upon the same subject; Rink's Greenland is reviewed in *Nature*, Nov. 22d; Die Indianer Canadas, *Globus*, xxxii; Aboriginal Pottery of Salt Springs, Ill., Geo. E. Sellers in *Popular Science Monthly*, Sept.; On the Antiquity of Man in America, Dr. Daniel Wilson in *Canadian Journal*, Oct.; two volumes of Maj. Powell's Contributions to American Ethnology will soon appear, Vol. II, by Gatschett, Mallery, and others, and Vol. III by Powers, Crook, Hazen, and Powell; Notes on the Zaparos, paper read before the London Anthropological Institute, Nov. 27th; Explorations of Don F. P. Moreno in Patagonia, *Geographical Magazine*, 1877, No. 8; Ueber die Eingeborenen von Chiloe, L. Martin in Zeitschrift für Ethnologie, 1877, H. 3; Das Land der Yukararer und dessen bewohner, H. v. Holten, same, Heft 2; Die gegenwärtige Läge der Indianer in den Vereinigten Staaten, Fred. v. Theilmann.—*O. T. Mason, Washington, D. C.*

GEOLOGY AND PALÆONTOLOGY.

A New Mastodon.—A new species of the *Tetralophodon* type has been recently discovered by Russell S. Hill, in the Loup Fork beds of Kansas, which is called by Prof. Cope (Palæontological Bulletin, No. 28) *T. campester*. It is allied to the *T. sivalensis* C. and F. in its dentition, and to the *T. longirostris* Kaup of Europe, in its lower jaw with prolonged symphysis. The specimen obtained has no indication of tusks in the symphysis, and the superior tusks have a broad band of enamel, which is not found in *T. longirostris* according to Vacek. *T. mirificus* Leidy, the only other American species of the group, has a short symphysis and a very different composition of the molar teeth. The *T. campester* is about the size of the African Elephant.

The Snout Fishes of the Kansas Chalk.—Prof. Cope recently read a paper before the meeting of the American Association for the Advancement of Science at Nashville, on the order of fishes named by him *Actinochiri* in the final report of the Hayden Survey, stating that the genus *Erisichthe* must be referred to it. Species in England had been referred by Dixon to the genus *Saurocephalus*, and Sir P. D. G. Egerton had discovered that they possessed a snout somewhat like that of the sword fish. Prof. Mudge ascertained the same fact regarding

the American species, and Prof. Cope discovered that the fin structure was that of the order above named. These fishes were, then, fully armed; first, with an acute bony rostral weapon; second, with large lancet-like teeth; and third, with acute-edged bony pectoral spines.

A NEW GENUS OF OREODONTIDÆ.—From the Upper Miocene (Pliocene) of Montana, has recently been described by Prof. Cope, a new genus of *Oreodontidæ*, which holds an interesting intermediate position. It has the full dental formula and preorbital fossa of *Oreodon*, but the premaxillary bones form a single mass, as in *Merycochærus*, and there is a large lachrymal vacuity as in *Leptauchenia*. It differs from the last genus in the absence of frontal vacuities. The molars are short-crowned, and not prismatic. It is named *Ticholeptus*, and the typical species, *T. zygomaticus*, is the size of *Oreodon major*. It has widely expanded zygomata, which have a horizontal plate-like extension at the glenoid region. The anterior face of the united premaxillaries is flat, and the nareal fissure is deep. The molar teeth are remarkable for their wing-like external ribs, which curve forwards. Length of molar series M. .097; width of premaxillary in front .032; length of cranium .225.

PALÆONTOLOGY OF GEORGIA.—Prof. Little, director of the Geological Survey of Georgia, has accumulated a valuable collection of the vertebrate fossils of that State, of cretaceous and tertiary age. Among these there have been identified the dinosaurian *Hadrosaurus tripos*, and the turtles *Taphrosphys strenuus* and *Amphiemys oxysternum*, a new genus and species related to *Adocus*. Mr. Loughridge of the survey also discovered a very fine specimen of that rare Propleurid, the *Peritresius ornatus*.

SILURIAN AND CARBONIFEROUS PLANTS.—Prof. Lesquereux read before the American Philosophical Society of Philadelphia, last October, two papers, one describing a fungus (*Rhizomorpha sigillariæ*), discovered under the bark of a *Sigillaria* from the Cannelton coal of Beaver Co., Penn. The other describes four species of plants from the Lower Silurian, viz.: a *Psilophyton* and *Sphenophyllum* from the Cincinnati group of Covington, and a *Psilophyton* and an *Annularia* from the Lower Helderberg of Michigan. The first remains of land plants from the Lower Silurian were discovered by Dr. Scoville in the Cincinnati beds near Lebanon, Ohio.

A NEW ALLY OF SIVATHERIUM.—Dr. R. Lydekker of the geological survey of India, has recently discovered a new genus allied to *Sivatherium* which is of much interest. It lacks anterior horn-cores, and has but a single base for horns on the vertex.

EXTINCT REPTILES OF INDIA.—Dr. Lydekker describes the first *Plesiosaurus* discovered in India from the Umia beds of Kach. He refers to the discovery of remains of *Megalosaurus* from the upper cretaceous of Trichinopoli, and mentions the existence of a huge dinosaurian in the Lameta rocks of Jabalpur. It is represented by a femur and caudal vertebræ, and he names it *Titanosaurius indicus.* He, however, does not define the genus to which he desires the name to apply.

PALÆONTOLOGICAL COURSE.—This course, at the Jardin des Plantes, by Prof. Albert Gaudry, includes an interesting discussion of the evidences of descent to be observed in the teeth and feet of the *Mammalia artiodactyla.* One part of it published in the Revue Scientifique is illustrated with many excellent cuts which convey important evidence to the eye. He refers to American observations in the same field, but commits a minor error in ascribing three upper incisors to the genus *Procamelus*, stating that Leidy has so determined it. The fact is that Dr. Leidy was unacquainted with the superior incisors of that genus, and that Prof. Cope first showed that it possesses but one, as in *Camelus.* Prof. Cope, however, discovered the genus *Protolabis*, which possesses the three superior incisors referred to by Prof. Gaudry.

GEOLOGY OF WISCONSIN.[1]—The Geological Survey of Wisconsin first instituted by the late Dr. I. A. Lapham, has been carried on with evident vigor by Prof. T. C. Chamberlain, and his assistants, R. D. Irving and Moses Strong. While Professor Chamberlain reports on the geology of Eastern Wisconsin, Mr. Irving describes that of Central Wisconsin, and Mr. Strong discusses the geology and topography of the lead region. An appendix on microscopic lithology is contributed by Charles E. Wright. The illustrations are numerous and excellent, and the atlas of thirteen maps further enhances the value of the report. We have been especially interested in the account of the surface geology of the eastern portion of the state, particularly the description of the ancient fiords which run into Lake Michigan, and the determination of the Kettle range to be an old terminal moraine, as abundantly proved by the interesting and excellent diagram facing p. 204.

GEOGRAPHY AND TRAVELS.

GEOGRAPHICAL WORK OF HAYDEN'S SURVEY.—A photolithographic plate of the primary triangulation carried on during the summer of 1877. by Mr. A. D. Wilson, Chief Topographer, has just been published by the U. S. Geological Survey, under the charge of Dr. F. V. Hayden. The area covered by these triangles extends from Fort Steele in Wyoming territory, westward to Ogden in Utah territory, a distance of about 260 miles, and north

[1] *Geology of Wisconsin.* Survey of 1873–1877, Vol. II., accompanied by an Atlas of Maps. Madison, 1877. 8° pp. 768.

as far as the Grand Teton, near the Yellowstone National Park, including Frémont's peak of the Wind River range of the Rocky mountains. The area embraces about twenty-eight thousand square miles, and within it, twenty-six primary stations were occupied and their positions accurately computed.

Besides these occupied stations a large number of mountain peaks were located, which in the future will be occupied as points for the extension of the topographical work of the survey.

A base line was carefully measured near Rawlins' springs, on the line of the Union Pacific railroad, and from this initial base the work was extended north and west to the valley of Bear river in Idaho territory. Here a check base was measured and the sytem expanded to the neighboring mountain peaks to connect with the triangulation as brought forward from the first mentioned base.

Along the line of the Union Pacific railroad the work was connected at six points with the triangulation system of Clarence King's 40th parallel survey.

In addition to the importance of this sheet as the base work of the season's topographical work it presents a most striking feature in the number of remarkably long sights which were taken from the summits of some of the most lofty mountains in the area explored. Many of these sights were over one hundred miles in length, while some reach a distance of one hundred and thirty-five miles. From Wind river peak all the prominent points in the Big Horn mountains were sighted, also the loftier peaks of the Uinta mountains; the former are located one hundred and sixty-five miles to the north-east, while the Uinta mountains are situated about the same distance to the south-west. As these ranges were not in the scope of the season's work they are not given on the chart.

The American Geographical Society.—In referring, however briefly, to the geographical work of our Transatlantic brethren, it must be considered a fitting opportunity to offer our congratulations to the American Geographical Society, which, incorporated in 1852, has now fully attained its majority; and the occasion is the more appropriate, as the society has recently acquired a new and commodious home, for which it is indebted to the public spirit and liberality so characteristic of American citizens, under the able direction of its distinguished President, Chief Justice Daly, whose eloquence and heartfelt regard for our favorite science cannot fail to have impressed his hearers during his late visit to this country. The American Geographical Society now numbers 1750 fellows, and possesses a geographical library of some 10,000 volumes and a large collection of maps, &c. Geographical operations on a large scale have been engrossed by the state in America; but the numerous and valuable papers contain-

ed in the twelve volumes of "Proceedings," "Bulletin," and "Journal," issued by the society since 1852, sufficiently attest the vitality of geography in the country at large.—*Sir Rutherford Alcock's address before the London Geographical Society.*

GEOGRAPHICAL NEWS.—Mr. Wetherman has published at Lima a valuable report on his exploration of the Peruvian tributaries of the Amazon, giving an account of an adventurous descent of the rivers Perene, Tambo, and Ucayali, in balsas, specially constructed for the purpose, says the *Geographical Magazine*.—A Dutch Arctic reconnoissance has been resolved upon by the Dutch Arctic Committee, which will dispatch in the next May a small sailing vessel of 85 tons to the Spitzberger and Barents seas. The expedition is paid for by the voluntary contributions of the whole people of Holland.—Herr Kiepert has lately presented to the Berlin Geographical Society a new map of Armenia, which embraces all available information and shows many additions to our previous knowledge of that region.—Among new books are, Upper Egypt, its People and its Products, by C. B. Klunzinger, M.D., with a prefatory notice, by Dr. George Schweinfurth (London, Blackie. 1878); The Monuments of Upper Egypt; A Translation of the Itinéraire de la Haute Egypte, of Auguste Marietto Bey (London: Trübner, 1877).

MICROSCOPY.[1]

THE POSTAL CLUB.—During the past year this society has continued its operations with full numbers, and with marked interest on the part of its members. The varied character of the objects contributed, and the sociable, gossipy nature of the notes, have made the boxes welcome throughout every part of the twenty-seven circuits. Comparatively few slides have been broken on the way or by careless handling, especially in those circuits where the new style of boxes has been in use; and scarcely any annoyance has been experienced except an occasional refusal of some postmaster to take the boxes because they contained glass. Even the difficulty in regard to the legality of mailing the slides has been as yet but a small and exceptional evil. The law against mailing glass is plain enough, the slides are unquestionably glass, and the objects are doubtless articles contained in glass; and it has been known from the first that to demand our rights under the law would be to break up the very useful practice of sending slides through the mails. Where the slides are properly packed and posted, however, without question or comment, there are very few postmasters known to be so stupidly officious as to take any notice of an act so perfectly harmless in itself and so entirely in accordance with the spirit of the law.

In addition to the regular boxes of the club, several contribu-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

tions have been made during the year of special boxes of such excellence as to require particular mention. One of these is a set of exquisite vegetable sections, double-stained in compound dye by Dr. Beatty's method, prepared and contributed by W. G. Corthel of Boston. Another, a series of unsurpassed crystallizations for the polariscope, by G. E. Bailey, of Lincoln, Neb. And a third, the beautiful preparations of Bermuda shells, by C. C. Merriam, of Rochester, already described in the NATURALIST.

During the year the club has lost two well-known members by death, Edwin Bicknell, of Cambridge, one of the most skillful of workers both with the instrument and at the preparing table, and Dr. Geo. D. Beatty, of Baltimore, one of the most talented, cultivated and promising of the cultivators of microscopy in this country.

The offices of secretary and treasurer have heretofore been combined, and ably filled by the Rev. A. B. Hervey, of Troy, to whose thorough and genial management the club is indebted for much of its success. The duties of the position having outgrown the time at his command and compelled him to offer his resignation, the managers have determined to recommend, instead of accepting the resignation, to divide the office and the labor by electing a separate treasurer who shall also act as assistant secretary. This change will doubtless be adopted by the club, and add to the ease and efficiency of its management.

A NEW MAILING BOX FOR SLIDES.—A new style of mailing box contrived by Dr. R. H. Ward, has been adopted by the Postal Club, and has proved successful beyond anything tried before. An account of it is therefore published in the hope that it may be made more generally useful.

In the boxes hitherto used for posting slides, the slides are occasionally found shattered to pieces, while the box containing them is quite uninjured or only a little strained. In some boxes containing six or twelve slides, half or more of the slides have been found broken in a perfectly sound box. This seemed to indicate not the effect of a crushing blow but the result of the inertia of the slide itself, which was only supported by the wooden racks at the ends and more or less perfectly by the cotton stuffed around it. An adequate occasion for such an accident might be furnished by throwing the mail-bag from a wagon to the pavement, or transferring it to or from a rapidly-moving train. It was therefore decided to reject the wooden rack altogether, and instead to support the slide by the whole of its edges and much of its sides by cloth, leather, india-rubber, or other soft and evenly-yielding material. This may be attained with the common boxes by removing the racks, lining the top, bottom and ends with thick, soft cloth, and arranging folds of the cloth, glued or stitched in place, like a rack at each end of the box so that a double thick-

ness of the cloth shall extend between the slides from each end one inch towards the centre. It is better, however, to have the boxes made for this use somewhat larger than the customary size, so that very thick beaver cloth can be used for the packing. For six slides a box may be made of hard wood 3-16ths of an inch thick, 3⅜ inches long, 1¼ wide and 1¼ deep inside measurement. The folds of cloth should be so arranged that not more than an inch in the centre of the slide is unsupported, except when large cover-glasses are to be used, when more space should be left to avoid pressing on the cover. The outside of the box is covered with strong thin cloth.

The comparative safety of this method is indicated by the experience of the Postal Club. During a trial of several months in many of the circuits, not one slide is known to have been broken while packed in this manner, while to slides in the ordinary boxes with wooden racks accidents are unfortunately frequent. For sending by express these boxes should be made of thicker wood, or enclosed in larger cases, to prevent crushing by the weight of heavy packages among which they may be carried.

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SCIENTIFIC NEWS.

— At the late meeting of the American Association for the Advancement of Science at Nashville, Tenn., Dr. T. Sterry Hunt presented a report on the subject of an International Geological Congress, from which we extract the following:

"The Committee to arrange for an International Geological Exhibition and Congress, to be held in Paris in 1878, was appointed by this Association at Buffalo, in August, 1876, and consisted of Messrs. W. B. Rogers, James Hall, J. W. Dawson, J. S. Newberry, T. Sterry Hunt, R. Pumpelly, and C. H. Hitchcock, together with T. H. Huxley for England, O. Torell, for Sweden, and E. H. von Baumhauer for Holland. At a meeting of the committee at Buffalo on the 25th of August, 1876, James Hall was chosen chairman, and T. Sterry Hunt, secretary. It was then agreed to prepare a circular, setting forth the plan of an International Geological Exhibition, which should form a part of the general Exhibition to be held at Paris in 1878, and indicating a scheme for the organization of the geological collections to be sent thereto by the nations taking a part in that exhibition, and, moreover, proposing an International Geological Congress to be held at Paris."

"The circular in accordance with this plan was duly prepared and printed in English, French and German, and before the end of the year had been sent by the Secretary to the principal scientific societies and academies, as well as to the workers in

Geology throughout the world. The response to this invitation has been most gratifying. The Geological Society of France has formally recognized the great importance of the objects proposed, and promised its hearty co-operation, while private letters from its President to the Secretary of the Committee, and from Prof. Hébert to Prof. Hall, give cordial assurances of the same kind. Spanish and Italian geologists have translated and published the circular in their respective languages, and have communicated to the Secretary their hearty approval of the plan. Prof. Capellini has, in this connection, published an interesting correspondence, calling attention to the fact that, in 1874, he had laid the project of a similar International Geological Congress, to be held in Italy, before the Italian Minister of Agriculture, Industry and Commerce."

"The Geological Society of London and the Geological Survey of Great Britain have also formally signified their approval of our objects, and the co-operation of Norway, Sweden, Russia and Austria-Hungary is promised. It is to be regretted that Germany has declined to take a part in the International Exhibition of 1878, but we trust that this will not prevent her geologists from joining in the proposed Congress. The Director of the Geological Survey of Japan promises to aid in our work, and we have the same assurance from Brazil, where the circular has been translated into Portuguese. Chili and Mexico have also responded, and promise an ample representation of their geology at Paris next year, while Canada, both through her Geological Survey and in the person of Dr. Dawson, will probably be represented there."

"The Government of the United States has as yet failed to accept the invitation of France to take a part in the Exhibition of 1878, so that American geologists are not certain that they will be able to participate in the International Geological Exhibition. We are, however, assured, that the Government is very desirous to have our country duly represented at Paris; and it is to be hoped that at the approaching extra session of the United States Congress measures will be taken for accepting the French invitation, and appointing a commission, so that our people may secure a representation in Paris. I am assured, on all sides, that our geologists desire to contribute largely to the International Exhibition, and even at this late day it will be possible to do much. In any event it is probable that several members of our committee will be present at the proposed Geological Congress. The precise date of this has not yet been fixed, though your Secretary is now in correspondence with the Secretary of the Geological Society of France upon this point, and believes that with the co-operation of that body, a time convenient to all will be agreed upon."

"It is recommended by the Standing Committee of the Asso-

ciation that, in addition to the names of J. P. Lesley, of Philadelphia, and Prof. A. C. Ramsay, director of the Geological Survey of Great Britain, already added to the International Committee, the Presidents, for the time being, of the Geological Societies of France, London, Edinburgh, and Dublin, of Berlin, of Belgium, Italy, Spain, Portugal, and the Imperial Geological Institute of Vienna, be invited to form part of our Commission."—*T. Sterry Hunt, Secretary of the International Committee.*

Shortly after the presentation of the above report the Secretary received official notice that the Geological Society of France had, in co-operation with the above plan, appointed at Paris a local committee of organization for the proposed Congress, constituted as follows: Hébert, president; Tournouer and Albert Gaudry, vice-presidents; Bioche, treasurer; Jaunetaz, secretary-general; Delaire, Sauvage, Brocchi and Vélain, secretaries; with the following, Belgrand, Bureau, de Chancourtois, G. Cotteau, Damour, Daubrée, Delafosse, Delesse, Descloizeaux, Desnoyers, Fougué, V. Gervais, Gruner, De Lapparent, Mallard, Milne-Edwards, Pellat, Marquis de Roys and L. Vaillant, members of the committee.

A circular issued by this committee, bearing date July 31, invites all those interested in geological, mineralogical and palæontological studies to take part in the approaching congress, and to subscribe the sum of *twelve francs* each, which will give a card of admission to the congress, and right to all the publications thereof. All those who intend to be present are at the same time invited to send, as soon as possible, a list of the questions which seem to them worthy of general discussion, as well as of the communications which they propose to make touching these questions. They are also invited to indicate which time appears to them most convenient for the meeting of the congress.

As regards an International Geological Exhibition, the Paris Committee of Organization state that the difficulty of finding a suitable locality seems to them an obstacle in the way of realizing this part of the programme. They hope, however, that there will be many special collections sent, and beg the exhibitors of such to give the committee due notice of these, in order that a special catalogue of them may be prepared.

The Secretary of the International Committee desires, in this connection, to call attention to the fact that his circular did not contemplate the holding of an International Geological Exhibition apart from the Universal Exhibition, but, in the language of that circular, *the making as complete as possible the Geological Department of the Universal Exhibition.*

It is certain that, as at all previous similar exhibitions, the different nations will contribute more or less of geological material, and it was conceived that such collections, extended and systematized in accordance with the plan set forth in the cir-

cular, would, while forming a part of the Universal Exhibition, without farther cost, meet all the requirements of an International Geological Exhibition. To the accomplishment of this end it will only be necessary for the exhibitors of all nations to send a list of their geological contributors to the local committee of organization at Paris.

All correspondence relating to the congress should be addressed to Dr. Jaunetaz, secrétaire-général, rue des grands Augustins 7, Paris, France, and all moneys sent to Dr. Bioche, at the same address.

— Russell S. Hill has recently returned to Philadelphia from Kansas, where he as been, for several months past, exploring for Prof. E. D. Cope. He discovered many fine vertebrate fossils, including a *Protostega gigas*, the bones of which, cleaned from the matrix, weighs three hundred pounds. He also discovered the new mastodont *Tetralophodon campester*, and numerous other mammalia.

ERRATA.—Page 51, second paragraph of Botany, first line, for "ized" read "ined;" second, for "Applopappus" read "Aplopappus;" fourth, for "mensiesii" read "menziesii" twice; seventh, for "empitriformis" read "empetriformis;" eighth, for "Erigonium" read "Eriogonum" twice; tenth, for "Polymonium" read "Polemonium;" next paragraph, for "Booth" read "Boott; also in first paragraph.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON, D. C., Nov. 24, 1877. —His annual address was read by the President, Prof. Joseph Henry. It included a sketch of the methods of scientific research, and an account of the progress of investigations into the phenomena of sound as exemplified by fog-signals. It was shown that experiments of all kinds tended to increase the probability that refraction of the sound waves or beams was the chief factor in producing the supposed abnormalities.

Lieutenent-Colonel Garrick Mallery, U. S. A., read a paper on certain errors, in general acceptance, in regard to our aborigines. It was especially devoted to showing that the number of Indians in the United States, exclusive of Alaska, in spite of losses by violent death, is probably on the increase, and that the discrepancy between their present numbers and the earlier accounts is chiefly due to the exaggerated and erroneous nature of the latter. This paper being unfinished when the hour of adjournment arrived, the remainder was postponed until the next meeting.

Dec. 8, 1877.—The same paper was continued. The author referred to poisoning arrow-points, belief in a single supreme spirit or deity, supposed knowledge of medicine or medicinal properties of plants, etc., as being in the category of popular

errors, time-honored but with slender foundation. The paper was the occasion of much discussion, and occupied the entire evening.

American Geographical Society.—Dec. 17, 1877, Mr. J. A. Bennett, Esq., read a paper entitled My first Trip up the Magdalena, and Life in the "Heart of the Andes."—Jan. 8, 1878, Rev. W. E. Griffis read a paper on Japan, Geographical and Social, with personal experiences.

Boston Society of Natural History.—Dec. 19, 1877, Prof. E. S. Morse made some observations on the habits and structure of Lingula, including his discovery of otoliths, which had not been previously known to exist in any Brachiopods.—Jan. 2, 1878, Dr. T. Sterry Hunt made a communication on some geological features of North Carolina, and Mr. J. A. Allen remarked on an "Inadequate Theory of Birds' Nests."

Appalachaian Mountain Club.—Dec. 12, Prof. G. Lanza described an ascent of Scar Ridge, a mountain lying north-west of Mt. Osceola, and Mr. Warren Upham spoke concerning some unnamed mountains between Mt. Hancock and Scar Ridge.

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SCIENTIFIC SERIALS.[1]

The Geographical Magazine.—December. Indian Famines and Sun Spots. Water-partings *versus* Ranges, by R. B. Shaw. The Arctic Föhn, by Sir G. S. Nares. Mr. Stanley's Voyage down the Congo (with Stanley's map of the Congo river).

The Geological Magazine.—December. American "Surface Geology," and its relations to British, by S. V. Wood.

Annals and Magazine of Natural History.—December. Report on the Echinodermata collected during the Arctic Expedition, 1875-76, by P. M. Duncan and W. P. Sladen. The Post-tertiary Beds of Grinnell Land and North Greenland, by H. W. Feilden. The Nomenclature of the Groups of Ratitæ, by Alfred Newton.

[1] The articles enumerated under this head are, for the most part, selected.